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FIELD-MARSHAL EARL KITCHENER AS SECRETARY OF STATE FOR WAR.

AN APPRECIATION.

By MAJOR-GENERAL H. L. PRITCHARD, C.B., C.M.G., D.S.O., Colonel Commandant, R.E.

(Written in 1938)

LORD KITCHENER was Secretary of State for War from 6th August, 1914, to 5th June, 1916, when he was killed in action by drowning at sea, in H.M.S. *Hampshire*.

He was holding the appointment of British Consul General in Egypt when the European War broke out. In Egypt, the prestige of his dominating personality was such that he was to all intents and purposes the virtual autocratic ruler of that country.

The beginning of August, 1914, found him on leave in England. The post of Secretary of State for War was vacant. The Prime Minister had temporarily taken it over from Colonel John Seely, who had recently resigned over the grave incidents in the Army resulting from the Ulster troubles.

When the European crisis burst upon the Cabinet at the very end of July, 1914, the Prime Minister had to find someone to relieve him of duty at the War Office at once. In the first instance, he turned to his Lord Chancellor, Lord Haldane, who had previously made a reputation as Secretary of State for War that will live in history. Lord Haldane answered the call of duty but urged Mr. Asquith to replace him by Lord Kitchener, for whom the country had begun to call with unanimity. Mr. Asquith was not the man to be hustled into action by popular clamour; but, exercising his usual cool, deliberate judgment, he decided that the public and his Lord Chancellor were right. He caught Lord Kitchener already on the boat at Dover about to return to his duty in Egypt. Lord Kitchener returned to London, attended the War Council on 5th August which debated the strategy that should govern the opening movements of the British Expeditionary Force, and the next day took up the duties of Secretary of State for War.

Lord Kitchener had not sought the appointment. He was under no illusions as to the magnitude and the difficulties of the task. No man saw more clearly what they were. But it was a call to duty from the whole nation, voiced by its Sovereign and his Prime Minister. There could be no question of a refusal and least of all from a man with Lord Kitchener's ideas of duty.

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Let us consider the task that faced him. His great predecessor, Lord Haldane, to whom every soldier will always be grateful and to whom every one of his countrymen owes an apology for the way he was treated, had, between the years 1906 and 1912, entirely reorganized the military forces of the country. This is not the place to explain what he had done, but it is necessary for our purpose to note that, after consulting exhaustively with his military advisers, to whom he has acknowledged his indebtedness, Lord Haldane evolved his own scheme to utilize to the very utmost by good organization all the military resources in men and materials which the nation reluctantly placed at his disposal in preparation for the Great War.

But what the nation was cajoled into providing almost unwittingly beforehand was one thing, and what the situation urgently demanded on 4th August, 1914, was quite another. Lord Kitchener was almost alone, perhaps he was alone, in visualizing instantly with absolute clearness the great scale of the events that were about to occur and of the efforts that our Country and Empire would have to make. He said at once that the war would last at least three years and that the United Kingdom would require an army of 70 Divisions additional to what the rest of the Empire would produce. Hardly anyone believed him, but everyone was prepared to place full confidence in him and co-operate wholeheartedly in his plans.

For his new appointment Lord Kitchener possessed the great asset that he had played a leading part in almost every part of the Empire. He had been conqueror and Governor-General of the Sudan and during his short tenure of the latter appointment (one year, 1898–99) he had laid deep and broad the foundations on which his successors raised an administration which gave such contentment to the population of the Sudan that they remained at peace throughout the Great War, except for a small rebellion on the outskirts in Darfur, quickly and skilfully suppressed.

Lord Kitchener had just returned from his important post in Egypt, a country in which he had spent many years of his service. He knew its defence problems by heart, he knew its great resources as a Mediterranean base for operations, he knew what risks could be taken in withdrawing all its regular British troops when relieved by a Territorial Division and in anticipation of reinforcement by Indian Troops.

Lord Kitchener had been Commander-in-Chief in the latter part of the South African War, where at the peace negotiations he had struck up a remarkable friendship with his opponent, General Louis Botha. They were kindred spirits, both big men in every sense of the word. Louis Botha was now Prime Minister of the Union of South Africa, and had told Mr. Lloyd George in 1911 that, in case

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of war with Germany, he would hold his country loyal and march 40,000 men into German South-West Africa. Kitchener knew Botha and knew that he might safely remove all the regular troops from South Africa.

Lord Kitchener had been Commander-in-Chief in India for seven years from 1902 to 1909. He had entirely reorganized the Indian Army and made it more efficient for war than it had ever been before. He knew exactly what it could or could not do. He knew to a nicety what risks India would be running by sending large forces to various places overseas to co-operate in the Great War, receiving in return three Territorial Divisions to complete their training. He knew to a hair's breadth the degree of risk in denuding India of nearly all her regular British troops. The C.-in-C. in India, Sir B. Duff, had been his own Chief of Staff. From London he was in correspondence with him on all these matters until this unconstitutional procedure was stopped, but revived with official sanction three years later by Sir W. Robertson as C.I.G.S.

Lord Kitchener when in India had struck up another remarkable friendship with the Amir Habibullah of Afghanistan. As C.-in-C., he had been Habibullah's cicerone in the latter's visits to India and had opened his eyes to the power of the British Empire and, incidentally, to the capacity of Lord Kitchener. On this knowledge and experience, the Amir—against the advice and wishes of nearly all the leading men of his country—formed the opinion that the British Empire were on the winning side, and that the right policy for his country was a strict neutrality which he persistently followed. He paid for this policy with his life but not until after the Great War had been won. It is difficult to compute in man-power and military resources, the value to India and the British Empire of the neutrality of Afghanistan.

In 1909 and 1910, Lord Kitchener after leaving India had been invited by the Governments of the Australian and New Zealand Dominions to advise them on the constitution and organization of their military forces, pledging themselves beforehand to follow his advice—a pledge which they duly kept.

All this stored-up experience and knowledge, and the associations he had created overseas, were of incalculable value in the urgent task of concentrating and then distributing to the theatres of war such forces as were available in the Empire when the war broke out. Seven months were required to complete the complicated imperial concentration of these forces. During those seven months, first six Regular Divisions were sent to France to take part in the early battles, followed at intervals by four more Regular Divisions, collected from all over the world, and another Regular Division (29th), similarly collected, was in England awaiting embarkation orders. Several Territorial Battalions of Infantry and some Terri-

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torial Field Companies, R.E., had been sent individually to France in response to our urgent calls for reinforcements, but Lord Kitchener had set his face firmly against the pressure of G.H.Q. in France to continue this process, which would have emasculated the Territorial Divisions. He was determined to preserve their divisional formations and send them overseas as complete divisions. Four Territorial Divisions had been sent to Egypt and India to complete their training and increase security. Five Indian Divisions and two Cavalry Divisions had been despatched to France, Egypt, Mesopotamia and East Africa. Nearly 40,000 Anzacs had landed in Egypt. The first Canadian Division was in France, leaving Depot Units and strong reinforcements in England : a second Canadian Division was forming in Canada. Botha had quelled a rebellion in South Africa and assembled 50,000 men, who were on the point of invading German South-West Africa.

At home, this intricate Imperial concentration was mainly the work of the War Office, the Admiralty and the Board of Trade with the Royal Navy and the Mercantile Marine; also the India Office. Overseas, the Indian Government boldly accepted the responsibility for risk and the arrangements for despatch of so many of their troops to theatres of war across the sea. The Dominion Governments had played their part well. But all these Government Ministries and Departments were sustained and helped in this work by their confidence in Lord Kitchener's advice and plans. Undoubtedly, deliberations which would otherwise have been lengthy were cut short, hesitations and delays were avoided, thus reducing considerably the time required for this great Imperial concentration. Lord Kitchener's experience and knowledge and the confidence he inspired were the mainspring of this achievement.

Critics have placed on the other side of the balance that Lord Kitchener had been so occupied in acquiring a unique experience of all portions of the Empire and its leaders that he had never served at home since he was a young subaltern at Aldershot. He was, therefore, ignorant of War Office organization, of the ways of the various Ministries of the Cabinet and the system of carrying on Government by Committee work. He likewise knew nothing of the great industrial and labour organizations of the United Kingdom.

He has been blamed for not founding the whole expansion of the Army upon the Territorial Army system. But what are the facts? He found 14 Territorial Divisions whose organization and preliminary training were to prove of incalculable value, but they had been recruited for home service only. A small proportion had accepted liability for service overseas. These Territorial Divisions included an appreciable percentage of elderly or partially fit officers and men who could render service at home only. The first task was to call

upon the Territorial Divisions to sort out those who now volunteered for overseas (about 60 per cent) and double this number by voluntary recruiting to complete establishment and supply 25 per cent for first reinforcement. That done, the next task was to recruit and form a second line of 14 more Divisions to go overseas (actually 8 second line Divisions left the country), and then to form third line depot units to recruit and train men for drafts to maintain the Divisions overseas. As fast as the Divisions were formed, their administration and training were taken over by the War Office. Surely this triple task for the Territorial Force was as much as the existing organization could manage, and right well was it done, vet with all that the Territorial Force could do, the Overseas Army supplied by the United Kingdom would still be 30 Divisions short of the figure of 70 which Lord Kitchener, with prophetic vision, had laid down as essential to beat the Germans. Events were to confirm that estimate. The formation of this balance of 30 Divisions had to be started simultaneously with the triple expansion of the Territorial Force. Urgency would not permit postponement of the New Army until after the Territorials had completed their expansion. It is unsound to ask any Unit to multiply itself by more than three. We have already noted how he saved the Territorial Army from emasculation. More creative " cells " had to be brought into existence and so the New Army of 30 Divisions was called into being by Lord Kitchener, whose personality was invaluable in obtaining a marvellous response from the Country. He would listen to no objections that there were no barracks, huts or tents; no clothes, no arms, no officers, no N.C.O's for the New Army. He struck while the iron was hot, he accepted the millions who volunteered. Within a year his New Army Divisions began to pour into the battles. Before the end of August, 1915, 17 New Army Divisions and 14 Territorial Divisions had gone overseas. Before he left England in early June, 1916, to meet his death, the last New Army Division had gone overseas. Surely this was a unique accomplishment for a Minister of War ; against this solid achievement we have the pure conjecture of the Pundits that it might have been done better some other way. Nowadays, people assert that we could have beaten the Germans without so many Divisions. Ask our allies what they think of that. Ask any Britisher from the Home Country or from the Dominions who was in battle whether he ever felt that we had more troops than we required.

While creating these large armies, the Minister of War was also responsible for the great expansion of the Royal Flying Corps. Of course, this was the work of many distinguished men but the official history of the "War in the Air" pays grateful tribute to the sound, far-seeing views of Lord Kitchener, the constant help, guidance, and sympathy which he gave to those employed in this task. In August, 1914, conscription was politically and administratively quite impracticable. At the end of six months, administratively it might have been made possible, but at what stage it became politically practicable is a controversial subject.

Space is not available for the proofs of the foregoing statements, but probably few will dispute them. Few also among those who have studied the last war will dispute that, for a war on such a scale, voluntary enlistment was radically unsound.

Undoubtedly, Lord Kitchener's preference was for voluntary enlistment at the beginning, quite apart from its administrative necessity under the circumstances of August, 1914. He was certainly not amongst the earliest converts to conscription, but at what stage he became convinced of its necessity it is difficult to say. Nor is it necessary, since the only factor that settled the date of conscription was political expediency and Lord Kitchener had not been made Minister of War in order to obtain his advice on politics. He considered that he had been called to the War Office to create, organize, and equip an army adequate for its task and to advise on how to use it. Conscription was, after the first few months, a political question. It became more and more obvious that the Minister of War could not provide an army without conscription. Lord Kitchener seems to have considered that provision and distribution of man-power was a matter for the politicians to settle.

The provision of munitions has been the subject of much controversy. The lack of munitions was a contributory but not the primary cause of the dissolution of Mr. Asquith's Liberal Cabinet and the formation of a Coalition Government in May, 1915. Our Country was not the only one in which Cabinets, or at least Ministers, were dismissed on the issue of munitions. The lack of or the possession of munitions made many decisions in the field. Starting from zero, trained soldiers can be provided much quicker than adequate munitions. Every belligerent was caught short on munitions, with some it came earlier than with others and the period of recovery from this shortage varied considerably. Germany at one end of the scale had made in peace what was then considered an adequate munition preparation for her large army and so supply lasted longer than with others. When the need for rapid expansion arose, Germany required to multiply her munition factories and resources by a comparatively small figure. At the other end of the scale, the small army we maintained in peace which was so quick in expanding had an absurdly small stock of munitions. Factories and resources had, therefore, to be multiplied by a very large figure to catch up the requirements of a rapidly expanding army in a war consuming munitions on an unprecedented scale.

When Lord Kitchener became Minister of War he was the heir to this totally inadequate provision for the task. Had he possessed a fairy wand, had he taken every conceivable measure with the utmost rapidity and without a single mistake in conception and procedure, the needs of the expanding army could not have been overtaken for many months running into years. The question, therefore, is whether it is reasonable to expect Lord Kitchener and those who worked with him in this matter to have produced earlier and greater results.

It was not until the first Battle of Ypres in October, 1914, that even those who were at the Front really began to visualize the unprecedented scale of consumption of ammunition, and the great variety of new types of munitions required in modern war between Great Powers.

In September, 1914, the Government had subsidized our armament firms with twenty million pounds to expand their factories. Lord Kitchener and his advisers on munitions relied in the first instance on our expert armament manufacturers, and on orders placed in America. It was considered that only those with long experience of technical procedure could manufacture arms and munitions.' Nor was this an unreasonable assumption. When necessity forced us to depart from this principle, the first products contained some very unreliable weapons and ammunition which added another risk to war that might have been demoralizing to men less prepared to face anything.

It was some time before it was realized that America was even less prepared than ourselves to fulfil the large contracts placed in that country. There was serious disappointment over promised dates of delivery, both at home and in America. Skilful and experienced as our armament firms were, it was some time before it was realized that the task was beyond them and could only be mastered by a national organization. Labour was wholeheartedly supporting the war but time was necessary to convince them that hard-won Trade Union restrictions were incompatible with war against enemies not bound by such checks to production.

These are only some of the unforeseen difficulties, the realization of which gradually unfolded a view of the enormous task before a nation totally unprepared for war on such a scale. Every individual in the nation must accept his share in the responsibility and give some sympathy and consideration to the man who, realizing the situation, yet accepted the task of directing the efforts to deal with it. In early 1915, it became obvious that a separate Ministry must be created to deal with the problem of provision, leaving to the Minister of War the responsibility for stating requirements. The new Ministry had for some time to live on what the War Office had arranged. Time was required for it to get into its stride. It was another eighteen months before a continuous increase of production amounted to a steady stream of everything our great armies required, in marvellous abundance.

The Battle of Loos, fourteen months from the outbreak of war,

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was fought with munitions produced under War Office direction. In this battle, the British soldier for the first time felt that he was giving the enemy what he had been compelled to suffer at his hands. To have worked up within fourteen months from almost nothing to a fairly satisfactory production for an army in the field multiplied by five or six is an accomplishment of which Lord Kitchener and the able men who did this work need not be ashamed. With all the knowledge and experience of the Great War now at our disposal, those who are charged with the responsibility for rearmament in 1936-38 are not finding it easy to equal the performance of 1914-15. They are probably great admirers of their predecessors.

In August, 1014, General Sir Charles Douglas who held the post of C.I.G.S. was unfortunately in bad health. In this condition, his gallant attempt to contend with his heavy task caused his very early death. There was some delay in filling the vacancy. The Directors of the General Staff and most of their subordinates had gone with the B.E.F. to France, a mistake which is unlikely to be repeated in any future war. The General Staff at the War Office was thus completely disorganized and took some time to recover. Some good men, e.g., General Callwell, were brought in but Lord Kitchener did not know them. Decisions were required urgently. Lord Kitchener was accustomed to giving quick decisions on military problems and had had very little cause to regret them. He took it as a matter of course that the disorganization of the General Staff would make an addition to the great burden he had assumed, and that it would save time if he used his great experience and knowledge to answer the questions that would normally be examined by the General Staff.

Before the end of 1915, Sir Archibald Murray had done much to reconstitute the General Staff, and the advent of Sir William Robertson in December, 1915, as C.I.G.S. completely re-established it in the exercise of its proper functions.

Up to the end of 1914, the war policy and strategy of the British Empire was virtually directed by the Triumvirate-Asquith, Kitchener and Churchill. In 1915, others were added to this War Council with doubtful advantage. Leading statesmen and soldiers of our allies had perforce to be consulted on war policy and strategy. They disposed of considerably larger forces on land, and allied consultation was essential, but much council confused the issues and delayed decisions. In 1914, we provided a good deal less than 10 per cent of the forces fighting the enemy in France. In 1915 we were fighting in many theatres of war with larger forces but still much below the numbers that France had put into the field. France, suffering invasion and providing by far the greater portion of the allied force in her country, rightly claimed and succeeded in exercising a dominant influence on war policy and strategy on the Western Front and, therefore, on the whole war. It was not until 1917, a year after Lord Kitchener's death, that the exhaustion and mutiny of the French Army caused the British Army in France, now greatly increased, to become and remain the paramount military force on the side of the Entente, though still by no means the largest.

Lord Kitchener had been a Commander-in-Chief in two Campaigns. He knew the value to a C.-in-C. of the trust and ungrudging support of a Minister of War and he gave it in full measure to Joffre. He knew the history of friction between allies and the consequent loss of power. His main purpose was to avoid or reduce this inevitable friction as far as possible, and to support, not only the British Commander-in-Chief, but also the French Commander-in-Chief, who commanded by far the larger proportion of the allied land forces on the Western Front.

He certainly was not partial to committee work or to large conferences. For sixteen years he had been a C.-in-C. or a Governor-General or High Commissioner. Such people do not sit on committees; they read the reports of committees and give decisions. To him the idea of making war plans with a committee was the same as discussing them with the enemy. He had been accustomed to serving one Ministerial Chief to whom he opened his heart and his mind. From the Prime Minister, Mr. Asquith, he had no secrets and he co-operated heartily and openly with his two colleagues at the Admiralty-the First Lord and the First Sea Lord, but there were few others to whom he wished to give his confidences. Hence we find Mr. Llovd George likening him to a lighthouse which flashes out a momentry beam of light at very long intervals. With a lighthouse this is certainly the experience of a single observer stationed at one spot, but inside the lighthouse the light is always burning; it illumines in turn every dark spot within the circumference of its sweed.

Unfortunately for the historian, Lord Kitchener has left no welldocumented war diary explaining his reasons and motives for the actions he took and the counsel he gave. He was not in the habit of holding post-mortems on himself or on anyone else. To this there is one important exception in the statement he read to the War Council on 14th May, 1915, recorded in its proceedings as follows: "When the Admiralty proposed to force the passage of the Dardanelles by means of the Fleet alone, I doubted whether the attempt would succeed, but was led to believe it possible by the First Lord's statement of the power of the *Queen Elizabeth* and the Admiralty staff paper showing how the operation was to be conducted. . . I regret that I was led to agree to the enterprise by the statements made, particularly as to the power of the *Queen Elizabeth* of which I had no means of judging."

To the proposal for operations at the Dardanelles, the first reaction

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of the chief naval and military expert advisers of the Government. Lord Fisher and Lord Kitchener, was, that if the enterprise was undertaken at all, it must be done as a combined military and naval operation acting by surprise. The first estimate of troops given at random by Lord Kitchener was 150,000. Lord Fisher gave rather a larger figure. Lord Kitchener's second reaction was that in 1915 we had not the men or the resources for two large offensive campaigns in separate theatres of war simultaneously. In January, 1015, he said he had no troops to supply for the Dardanelles and added : "We shall not be ready for anything big for some time." Space does not permit us to thread our way laboriously through the maze of counsel given by many counsellors which caused Lord Fisher and Lord Kitchener to be swept off the rock of sound naval and military principles which they laid down at the beginning. The controversy between those who discuss the relative advantages of the Western Front or the Dardanelles in 1915 will doubtless continue for ever, but there seems now to be no controversy over the opinion that the Entente in 1915 had not the resources for large-scale offensives in both theatres of war.

. Thus we see that Lord Kitchener in the making of war plans and forming the strategy of the war, though he undoubtedly exercised for some months a powerful influence, never had a free hand. Mr. Winston Churchill has said : "No one had supreme power." For the first three years, conditions almost compelled subservience to French strategy on land. Lack of early success brought about a Coalition Government, with inevitable weakening of the Prime Minister's power and a great addition to the number who could force their opinions and advice to be considered. These numbers were much increased by the necessity to be in constant conference with allies, deferring to their views. Lack of success in 1915, and on our part lack of adequate previous preparation in peace for such a task caused the initiative to pass to the enemy, with the usual consequence that we had to make war "not as we would but as we must."

To sort out from this medley the degree of responsibility attributable to Lord Kitchener or to anyone else for the success or failure of any strategical decision is impossible within the space available.

In every belligerent country, every soldier in high command and every statesman charged with great responsibility has not only a credit but also a debit side to his account. One can, however, say confidently that Lord Kitchener's account shows a credit balance of services rendered to his country and its allies at least as great as, and possibly greater than, that of any man on either side.

THE GERMAN ENGINEERS IN THE CHEMIN DES DAMES OFFENSIVE, 1918.

By BRIG.-GENERAL SIR JAMES E. EDMONDS, C.B., C.M.G., D.LITT.

ON the 27th May, 1918, the Germans achieved one of their most spectacular triumphs. In one rush, with twenty divisions against ten, they drove the French Sixth Army, under General Duchêne, off the Chemin des Dames ridge, though it was guarded in front by the Ailette stream; drove the French and a British contingent with them over the Aisne river and its accompanying canal which lie behind the ridge; pursued them over the almost roadless Vesle ridge, situated between the Aisne and Vesle rivers, and by nightfall had reached, and in places had crossed, the Vesle, ten miles from their starting line. The story is not without many useful lessons.

The Ailette in its upper course has marshes 100 to 200 yards wide, the water being 3 to 5 feet deep; the lower course is canalized, the water-channel being 60 feet wide. The Aisne, above its junction with the Vesle, is 50 to 70 feet wide; but below this point it widens out, and at Soissons is about 180 feet wide. Its lateral canal is about 60 feet wide, and the space between it and the river is flat and, in May, covered with high grass. The Vesle is 35 feet broad at Fismes, has wooded banks and is quite a serious military obstacle.

The German success was largely due to the engineer troops, of whom no less than 94 companies were employed.* Their doings are described in their unit histories, in the Book of Honour of the German Field Engineers (Das Ehrenbuch der deutschen Pioniere), and in an official monograph on the battle, Das Vordringen der 7. Armee über Ailette, Vesle und Ourcq.

The Chemin des Dames position was regarded by the French as a model one, and shown as such to visitors. It was on the top of the ridge, the north face of which is steep, the southern slope being longer and cut by numerous valleys. At its eastern end, near Craonne, the ridge drops sharply, and the French front line ran over low ground, broken by a wooded ridge at Brimont, to Reims. The recently arrived British IX. Corps (consisting of the 8th, 21st and

^{*} The German engineer troops are called "Pioniere," but the units are made up of tradesmen, like R.E. field troops. There were no troops corresponding to our Pioneer battalions except the "Armierung" companies, primarily intended to complete the defences of fortresses on mobilization. The officers employed on fortification work were called "Ingenieure," but were on the same list and interchangeable with the "Pioniere."

50th Divisions, with the 25th in reserve), under Lieut.-General Sir Alexander Gordon, held the eastern shoulder of the position, having been sent to the Aisne for rest by General Foch, then interested in mixing up the French and British troops.*

With a widish river in rear of the position, the guarding of the bridges, both the permanent and the many temporary constructions, and their preparations for demolition, were of importance. It is sufficient to say here that the failure of the French to destroy the bridges in their sectors was an important factor in the rapid progress of the enemy. General Duchêne had issued an order that no bridge over the Aisne was to be blown up without his authority. It was not until 4.30 p.m. on the 26th that he telephoned to the corps that an attack was imminent, and at I a.m. the enemy opened the bombardment. The French Official History, Tome VI, Volume II, gives the following explanation of the failure to destroy them :—

"the order arrived too late (11.30 a.m. on the 27th) at General de Maud'huy's headquarters [his corps was on the British left]. The Germans were already masters of seven passages and held the others under machine-gun fire [how they got there we shall see]. On that account the order to charge the chambers, given verbally between 8 and 8.45 a.m. to the Chief Engineer of the Army, could not be completely carried out. The engineer parties were caught at work by the enemy. . . . Nevertheless the British 8th and 50th Divisions were able to destroy part [nearly all, in fact] of the passages of the Aisne and the canal."

That the two British divisions concerned were able to render this important service was due to the fact that at 12.30 a.m., exactly twelve hours before General Duchêne's order reached him, Lieut.-General Gordon had given instructions for the final measures to be taken, and the R.E. officers on the spot fired the charges on their own responsibility.

The nature of the German engineer preparations is exemplified in the account given in the Official Monograph of those made by the corps (Conta's) which was opposite the western junction of the French and British. Woods which stretched nearly to the Ailette provided cover and convenient hiding-places. The following are the items :—

"(a) Construction of 24 footbridges in each of the three divisional sectors for the passage of the Ailette, and the dumping of the material as far forward as possible and opposite the places where it is to be used. Reconnaissance of these places and the routes to them.

* Gordon's dissatisfaction with the position and the distribution of troops on it can be read in the British Official History, "1918," Vol. 111.





"Preparation, after reconnaissance, and placing ready of numerous bridges for the passage of the marshy ground in the Ailette bottom.

" Repair of main roads to within a quarter-mile of the Ailette.

"Collection of the necessary material for the passage of the shell-cratered area, and for the repair of roads across this area up to the crest of the Chemin des Dames.

"Collection of material for the construction of five heavy bridges over the Ailette and for bridges over the Aisne.

"(b) As soon as the artillery bombardment begins : loading up and transport of the bridging material (for the footbridges and five heavy bridges) to the Ailette, construction of the footbridges and the passage over the marshes : at the same time the removal of all obstacles on both banks. Construction of the five heavy bridges.

"Completion of up and down tracks from the main roads up to and beyond the Ailette. All the work must be completed before the assault.

"Strengthening of the heavy bridges and improvement of the up and down tracks; advance behind the infantry to repair the tracks in the shell-cratered area in and beyond the French positions; assistance to the advance of the batteries, the infantry transport, machine-guns, trench-mortars, etc. For these purposes three resting infantry battalions of the position divisions should be employed; they should arrive at the bridges about an hour after the beginning of the assault; their first business will be to assist the heavy artillery of the assaulting divisions up the hill to the top of the Chemin des Dames ridge. Further work: the reconnaissance and construction of cross-country tracks alongside the main roads; bringing up bridging material for the passage of the Aisne; assistance to divisions in bridging the Aisne, if this is ordered."

A diary of an N.C.O. of the 1st Guard Engineers Battalion, which is available, gives some details of another kind. During the 20th-24th his company marched by night, the baggage being carried by lorry. On the morning of the 25th the company received the order : "The 3rd Section will make ready for assault on the night of the 26th-27th. The 1st and 2nd Sections will remain behind for the time being." The men were loaded up with incendiary flares (*Brandröhre*), wire-cutters, six hand-grenades each, demolition charges and fuzes, battle equipment, iron rations, food for three days. Floats for footbridges were got out and packed on the toolwagons, which were to be taken as far forward as possible. The men were told that their task was to remove wire and obstacles not destroyed by the artillery fire, and by means of hand-grenades and incendiary flares to drive the enemy from caves, dug-outs and other shelters, and so facilitate the assault of the infantry. At midnight (British time) the company was in position in the front trenches. The bombardment which began at I a.m. was to last 2 hours and 40 minutes; but at 2 a.m. the men crept out of the trenches through the Ailette marshes as near as they could to the French line; the shells which fell short in the marshes did no harm, but fragments of them occasionally rattled on the steel helmets, so " the men's noses make the acquaintance of the Ailette mud. Our work in the assault begins with the wire-cutters." A few grenades were thrown into the dug-outs, but the second line attended to mopping them up. "With fire and smoke, the French are forced to surrender ; others run so fast that we have no use for our bayonets. Nothing holds us back but our own artillery fire: such a rapid advance had not been expected. Little remained to do except to remove obstacles and make a clear road for the artillery."

The following extracts are taken from the report of the General of Engineers of the German Seventh Army on the activities of the Engineer formations during the battle :---

. "To describe the doings of all the 94 companies would take far too much space. Here only some examples of their work can be given. They will be sufficient to show how greatly the success of the operations depended upon the engineers. It will be convenient to take each of the five corps in turn.

" Larisch's Corps (the German right corps directed on Soissons and westward)* : Before the attack the Pikot of the 5th Division, a captain, had by means of air photographs given full instructions to his two company commanders for the case of a break-through as far as Soissons, and for their companies to carry out the reconnaissance of particular crossings. Two engineer officers' patrols were attached to the leading infantry for this purpose. On the evening of the 28th, as soon as the 12th Grenadiers had captured the heights north of Soissons, near Crouy, but for the moment did not intend to advance farther, the patrols proceeded at once to their work. A couple of volunteers from the Grenadiers and a machine-gun went with them. Both patrols managed to reach the far bank of the Aisne by the undestroyed railway bridge above Soissons, and hurried as fast as possible to the crossings indicated. They reached the first undetected and by their fire drove off the French, who were either making preparations to destroy the bridge or in action against the attackers on the north bank. In great haste the French fired what charges were already laid, which did

* The corps boundaries, but not their names (mostly non-Aryan), are shown on the sketch map.

[†] Commander of the Pioniere, the equivalent of C.R.E.

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not do much damage. The second patrol then pushed on to the second bridge, where it repeated the manœuvre with like success. The French demolition parties tried several times to return to the bridges, but were always driven off. The sappers pulled out the fuzes, removed the charges and guarded the bridges until the leading battalion of the Grenadiers arrived and took over.

"The two engineer companies of the 6th Division had great difficulty in throwing the infantry footbridges over the Ailette canal, as the machine-guns on the farther side had not been smothered; but the losses were not heavy (14 killed and 23 wounded). The sappers had to take action to prevent a panic amongst the carrying parties.

"Two corps companies constructed a timber bridge for heavy vehicles over the Ailette 50 metres long and 6 metres above the water surface in 10 hours, so that it was ready by 5 p.m. on the 27th.

"Wichura's Corps: The bridging of the two arms of the Ailette on the Chevregny-Abia Farm road and the removal of traps on the Chevregny-Maison Rouge road had been carefully prepared for by a Landwehr engineer company, and was so quickly carried out that by 4.30 p.m. the heaviest vehicles could pass over the bridge and the road. A Landsturm engineer company, which did not reach the site until 12.30 p.m., finished its first task, a heavy bridge on the Urcel-Chavignon road, by 8 p.m.

"Winckler's Corps: A battalion of three companies on the 27th May had the task of facilitating the passage of the infantry over the Ailette marshes by the construction of 24 footbridges and then the replacement of two bridges damaged by demolition charges for the artillery, as well as assisting its change of position across the shell-holes and trenches on the steep northern slopes of the Chemin des Dames ridge. Its further tasks were : the removal of obstacles in front of the French position, bridging the French trenches where roads crossed them, and the building of a heavy bridge over the Aisne and its canal. To make the footbridge it was first necessary to lay a foundation of fascines of suitable depth and the carrying parties had to make the double journey five times under enemy harassing fire ; but the casualties were only 11 dead and 16 wounded. The tracks across the Ailette and up to the top of the ridge were usable by 10 a.m., and the heavy bridge by 3 p.m. One engineer patrol of another battalion, attached to the infantry, secured one of the Aisne bridges by a hand-grenade attack. A second patrol reached the bridge at Bourg before the infantry, fired on the French transport which was crossing it and withdrew the demolition charges under fire of its own artillery then falling on on the bridge. Engineer parties with incendiary flares (Brandröhre) attacked machine-gun nests, small posts and shelters.

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"Conta's Corps (left wing, opposite the British left wing): Three companies of a G.H.Q. engineer battalion had laid bridges for crossing the Ailette marshes half an hour before the artillery bombardment began. A section of one company attached to the infantry, after taking a farm and small village from the French, reconnoitred the way to the next village and guided the infantry to it, so that no time was lost. One company which accompanied the 28th Division advanced with it to Jaulgonne on the Marne (25 miles south of the Aisne), and at I a.m. on the 31st May crossed the river in half-pontoons, and were the first men of the division to get over. From 3 a.m. onwards the ferrying on rafts was continued until daylight, when enemy artillery fire on the landing-places damaged a number of pontoon and rafts. The material was, after great exertion, hidden during the following two nights.

"The divisional engineers of the 5th Guard Division were the first troops to reach the Aisne.

"Schmeltow's Corps (opposite to British centre): An engineer officer's patrol prevented the demolition of a temporary bridge over the Aisne south-west of Pêcherie Farm (3,000 yards west of Berry au Bac); the commander of another company swam the river under machine-gun fire and brought back a French pontoon, and by 11 a.m. had carried a hundred men over, who prevented the demolition of the canal bridge further south."

ENGINEERS IN THE BLITZKRIEG.

The following article by CAPTAIN PAUL W. THOMPSON, Corps of Engineers, published in the "Infantry Journal" (Washington), September-October, 1940, is reproduced almost in full.

EARLY on the morning of May 10th last, a German engineer battalion, motorized and strongly and peculiarly reinforced, rolled westward over the road Aachen-Maastricht. The battalion was travelling with the advance guard of a division—one of the many which, at 5.30 that morning, had crossed the three frontiers—Holland, Belgium, Luxembourg—as the great Entscheidungskampf im Westen (decisive battle in the West) got under way.

This particular division—the one advancing toward Maastricht had immediately ahead of it a job which, of all those facing the invaders, must have rated tops, both in difficulty of execution, and in importance. For just across the ten-mile-wide, almost undefended, and almost undefendable Maastricht Appendix, lay the strong fortified line of the Albert Canal. And the keystone of that line, most formidable of the works around Liége, "one of the strongest fortifications in Europe," was Fort Eben-Emael. Fort Eben-Emael lay four miles south of Maastricht, within the sector of our advancing force.

What I have so far written is intended to illustrate a cause-andeffect relationship---the cause, a strong fort in the path of an advancing force; and the effect, an engineer battalion, peculiarly reinforced, well to the front of the advancing force. The mission of that engineer battalion was to assault and reduce the fortifications at Eben-Emael --by German doctrine a typical engineer mission.

The German language, with its wealth of succinct military terms, has a word for the engineer : he is the Bahnbrecher (the breaker of the way) for the infantry. He is the Bahnbrecher whether the obstacle is a crater to be filled, a minefield to be destroyed, a stream to be bridged—or, a fortification to be reduced. As the Bahnbrecher, his work is connected not remotely but intimately with that of the infantry. And frequently, as in the case described in the opening paragraph, he operates as the very spearhead of the attack. So, not only is he a Bahnbrecher; he is also a Kampfer—that is, a combat and not a technical, soldier. Of this latter fact he is proud, and his feelings often are reflected in his actions and his remarks. For example, he calls himself a *Pionier* (not an *Ingenieur*). And among the things that an officer of *Pioniere* would classify as nonessential is the degree in engineering which attaches to his American counterpart. Every consideration of the German engineer battalion evidences this emphasis on *combat*—on combat engineering as involved in getting the infantry forward. The battalion is organized, equipped, trained, and indoctrinated to that end. Before looking further to the end itself, we may well examine the means through which the end is attained : organization, equipment, training. For this purpose I shall make specific reference to the engineer battalion of the regular infantry division, since that battalion is the model for all other general engineer units in the German Army.

ORGANIZATION OF THE ENGINEER BATTALION.

The engineer battalion of the German infantry division is organized about as shown. Except for the trains, the organization could be



Basic organization of German engineer battalion.

that of an infantry unit (less the supporting-weapons units). Each engineer company has its three platoons, each platoon its three sections, and each section its two squads. As in German infantry units, one of the squads is built around, and takes its name from, a light machine gun. The section serjeant commands this light machine-gun squad and in addition to him the squad contains four enlisted men. As in infantry units, the other squad is called the rifle squad. The section corporal commands it, and it contains eight other enlisted men. Each man in the squad is armed with the calibre •30 carbine. Thus the strength of the section is about fourteen enlisted men. With this as a basis, and making some assumptions as to the strength of headquarters and trains, the company figures out at about five officers and 190 enlisted men; that of the battalion at about twenty officers and 750 enlisted men. The ratio—officers to enlisted men—is accordingly about one to thirty-seven.

The infantry division of which this engineer battalion is a part is itself a triangular organization. It has three infantry regiments, two artillery regiments, a signal battalion, and the service and supply units. The aggregate strength of the division is perhaps 14,000. Thus the ratio—engineer strength to aggregate division strength—is about one to eighteen.

TRANSPORTATION.

Those who have followed the course of events in Europe have remarked the continuing presence of the horse throughout the German Army. For what it is worth in this respect, the engineer battalion is a case in point. Two of the three companies in the battalion are called "foot" companies. In these, all platoon tools are carried in horse-drawn wagons. In company headquarters of the foot companies there is some motor transportation. The soldiers march afoot. The third company, all trains, and the battalion headquarters, are completely motorized.

The wagons that carry two-thirds of the platoon tools (those in the two foot companies) are small—each drawn by two horses. The trucks that carry the other loads are large—five tons or so unloaded. Most of the trucks have three axles, with all six wheels powerdriven. Reconnaissance cars are open and powerful, with four-wheel drive and four-wheel steering. Some of the prime movers in the bridge train are half-tracked. The pontoon and trestle equipage is carried on four-wheel trailers. All of these vehicles are *Einheits* models, standard throughout the German Army. All have great power and great cross-country ability.

Owing to the use of such large vehicles German motor columns are relatively short and heavy. That is an especial advantage in a country where roads are many and good and where drivers are also few and poor.

ARMAMENT.

The basic arms of the battalion are the light machine gun and the carbine. These fit into the organization in the manner already described. Except for two men in the light machine-gun squads, all enlisted men carry the carbine. Officers carry the pistol. Thus the armament is the same as that of the infantry company. The engineer battalion lacks, of course, the accompanying weapons found in the infantry regiment.

EQUIPMENT.

The appearance of the German soldier, with his full helmet, cylindrical gas mask, and leather boots, has become well known through the photographs that have appeared during this and the other war. Everything is so much in order that one is reduced to commenting on the fact that the German engineer soldier does, whereas his American counterpart does not, carry an entrenching tool on his back.

Explosive is the fundamental engineer material, and the Germans give it attention commensurate with its importance. The standard German explosive is TNT, and it is found in considerable quantities in units from the platoon up. Not only is the explosive there in quantity; there also is an issue, size, and shape for almost any purpose. A $\cdot 2$ -kilogram ($\cdot 44$ -pound) block is the form used for general demolitions. A cylindrical block is adapted to small boreholes. A \mathbf{I} -kilogram slab is used for making Bangalore torpedoes and for other distributed charges. A $\mathbf{3}$ -kilogram block forms a powerful concentrated charge (geballte Ladung), peculiarly useful in certain operations I shall describe later. Along with these explosives go conventional fuses and detonators—and, in addition, a detonator that operates on a delay principle, like that of a hand grenade.

Closely allied to the explosives described above are the grenades and mines. These are carried in quantity by all units from the platoon up. The German tank-mine is large, calculated to do more than simply break the tread of the enemy tank. The German hand grenade is the "potato-masher" of World War fame.

All German engineer units are equipped to lay quick obstacles (Schnellsperren) at a moment's notice. These obstacles are carried in all vehicles likely to see action. They include the mines mentioned in the paragraph above, steel-wire rolls similar to the American ones, and various types of mines improvised from issue explosives.

Also useful in the erection of obstacles, and in many other operations, are the power-saws carried in the platoons. These are powered by single-cylinder gasoline motors, and each can be carried and operated by two men.

German units are equipped with air-compressors on about the same scale as are American units: two per company. However, the German compressor is towed as a single-axle trailer, while the American one constitutes the built-in load for a r_2^1 -ton truck. Incidentally, the American power-saw works off the air-compressor (in contrast to the German one, which, as has been mentioned, is gasoline-powered).

Engineer floating-bridge equipage the world over falls naturally into several classifications : assault and reconnaissance boats, footbridges, light bridges (say, to five tons), division-load bridges, heaviest-load bridges. It is a characteristic of the German Army that the various classes of bridge equipage are carried relatively far down in the organization. For example, the *combat company* has its own reconnaissance and assault boats, and the *battalion* carries some pontoon and trestle equipage.

The American solution to the reconnaissance and assault problem



German "pneumatic boats" in use somewhere in Flanders.

is the light wooden, nesting "assault boat," the British solution is a "folding boat," and the German solution, a "pneumatic boat." The latter is deflated, rolled, and sacked for transport on the road, and is inflated (by a bellows pump) and stiffened with a wooden floor for use in the water. It is bulkheaded off into compartments so that a single puncture does not cause it to sink. It is carried in various sizes, the most common one being about nineteen feet long and seven feet wide, with a buoyancy of about two tons and a weight of about 350 pounds. The Germans have used the pneumatic boat very extensively during their recent operations. This fact is attested by the number of times in which pneumatic boats have appeared in photographs of these operations. One such photograph shows the boats in use as piers for an improvised footbridge (over the Meuse River ?). Other photographs have shown the boats in use as

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individual boat-ferries, assault boats, multiple-boat rafts, piers for light (say four-ton) pontoon bridges.

The Germans have no footbridge as such. The manner in which footbridges are improvised has been noted above.

The German battalion carries a pontoon and trestle equipage which assembles into a bridge carrying loads to about five tons. From the technical viewpoint, it is interesting chiefly in the manner in which baulk and chess are combined into single "units of superstructure."

The standard German pontoon and trestle equipage assembles variously into two types of bridge : the normal bridge, taking loads to about nine tons; and the reinforced bridge taking loads to at least twenty tons. The bridge has been used extensively in the operations over the numerous waterways of western Europe. Apparently it is capable of taking all loads in the *panzer* division. From the technical viewpoint, the bridge has many interesting features, such as the use of square-end half-pontoons and the use of I-beams for baulks. The characteristics of the bridge are such that it must be assembled by the method of rafts—this resulting (usually) in rapid assembly, but requiring a high degree of skill in watermanship on the part of the construction crew.

TRAINING.

In peace-time the German engineer officer had two years in which to convert his conscripts into engineer soldiers. The time was utilized to the last minute. It was nothing unusual to see a company build and dismantle a pontoon bridge, and repeat the operation six times over, in the course of an afternoon. It was nothing unusual to see a company take off in the morning, march ten miles without pause, go through an exercise, and march back home. There were many practical exercises, often with units from other arms participating. Invariably the exercises were as kriegsmässig (alike to war) as it was possible to make them. There was an air of seriousness, of determination, of reality about everything. And in the background, dominating the scene, was the idea that the engineer is not a technician but a Kampfer.

THE RESULT : FLANDERS AND FRANCE.

With this brief preview of the German engineer battalion, we may return to the battalion that was rolling along toward Maastricht early on the morning of May 10th with the mission of assaulting Fort Eben-Emael. Accomplishment of this mission involved the use of *Pionier Stosstrupp Taktik*—a German phrase which I shall translate

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here as "engineer assault tactics." These factics present the Bahnbrecher in his most fighting form.

The essence of assault operations as applied to the reduction of fortifications lies in coming to grips with the individual emplacements, and in the application of explosives to them. The process of closing with an emplacement involves protection from the fire of that and other emplacements, and protection against counterattacks. Thus, the work of the engineers must be supplemented by the actions of other arms. In fact, assault operations constitute an outstanding example of the precise co-ordination between infantry, air force, artillery, and other arms that has characterized German operations throughout the recent campaigns.

The composition of an engineer assault detachment is dependent, of course, on the mission in hand. As already noted, the engineer component of the detachment charged with reducing Eben-Emael was a full battalion. Attached to the battalion was a force—probably about two companies—of infantry, and some anti-aircraft batteries (probably 20-mm. guns). For this particular mission the detachment was motorized, and was travelling with the advance guard of the division.

The prime items of equipment carried by the engineers in the assault detachment are the explosives by which the emplacements will ultimately be demolished. In this connection, the large 6-6pound block, fitted with delay grenade-type fuse, is especially effective. There are also the items of special equipment used in getting close enough to place the charges, and in actually placing them. Among these special items are flame-throwers for blinding and scaring ; thermite grenades for blinding, searing, and melting ; smoke candles for blinding ; ladders for scaling ; long poles for · placing charges in inaccessible places. Incidentally, the long chargeplacing poles appear (broken down) on the packs of several of the party shown crossing the footbridge in the photograph on page 478.

The reduction of Fort Eben-Emael is an excellent and typical example of the technique involved in assault operations. The detachment arrived at Maastricht within an hour of crossing the border, and after very little delay (and after incidents not pertinent to this account) succeeded in crossing both the Meuse River and the Albert Canal. The detachment then was on the Eben-Emael (west) side of canal, and about four miles north of the fort.

Fort Eben-Emael was on a bluff almost two hundred feet above the surface of the canal. It overlooked both the canal and the river. It was occupied by a force of about 1,300 officers and men. The general layout of its most important works are shown in the figure. It was considered to be all but impregnable.

Beginning at 5.30 a.m., May 10th, the fort had been taken under heavy bombardment, especially by the German air force. As the bombardment proceeded, the assault detachment worked itself southward along the west bank of the canal. Its progress was slow; it was held up by fire from the fort and from numerous machine-gun nests over the countryside. By late afternoon, however, the detach-



Elements of Fort Eben-Emael.

ment had reached the small stream running along the foot of the bluff just north of the fort. The stream was unfordable.

Meanwhile, late in the morning, the bombardment had ceased, and had been followed without delay by the landing of a parachute detachment within the fort. This detachment appears to have been composed of engineers, and was commanded by an engineer officer.
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It succeeded immediately in establishing contact by radio with the advancing assault detachment, and thereafter kept this detachment informed as to the situation within the fort. Details as to whatever other actions the parachute detachment may have taken are lacking.*

Arrived at the unfordable stream, the assault detachment took cover, and awaited the coming of night. During the night, pneumatic boats (which had been used in crossing the Meuse at Maastricht, and had been left there) were brought forward and the detachment crossed the stream. It now scaled by ladder the steep slopes leading to the upper level of the fort. Details are lacking but it appears that the parachute detachment must have covered these operations. In any event, the coming of dawn saw assault and parachute detachments join forces. The assault began forthwith.

We can assume that the assault progressed in normal fashion. Certainly it had been rehearsed in detail. The A.A. guns went into battery, firing direct at the ports of individual works. The infantry prepared to repulse any sorties or counter-attacks. The engineers crawled forward, concentrating on certain individual works. They carried their explosives, grenades, smoke candles, flame-throwers, poles, and other equipment. They took advantage of the blind areas formed by their own smoke, and by the many craters resulting from the bombardment (these craters being, incidentally, the chief benefit deriving from that bombardment). If they encountered wire, they cut through it with Bangalore torpedoes. Finally, they reached the outer walls of the works themselves.

Here the scene must have been one of terrifying action. Flamethrowers are playing against ports, grenades are bursting, projectiles from the A.A. guns are ricochetting, and engineer soldiers are hugging the dead spaces, throwing and placing their charges. With their explosives they are attacking the sensitive parts of the work, the ports, the turrets, the hinges.

At Eben-Emael this sort of assault continued through the morning. One by one the works and emplacements were rendered untenable. At 12.50 p.m. the Belgian commander raised the white flag and surrendered to the engineer lieutenant-colonel commanding the assault detachment. The Battle of Flanders was barely thirty hours old, and the German engineers had already done much to destroy the myth of the invulnerability of the great post-World War frontier fortifications.

Actually, and as in other phases of the blitzkrieg, there is nothing fundamentally new about assault tactics as practised at Eben-Emael. Even to the flame-throwers and the supporting weapons, the assault

^{*} Newspaper accounts of this operation hinted at the use by the parachutists of a mysterious gas, calculated to paralyse the enemy. No confirmation of the paralysis-gas rumour has been forthcoming.

detachment of 1940 is the Sturmbataillon of 1915. The single new wrinkle appears to be the parachutists—and it appears that they figured only in the assault of Eben-Emael—and not decisively there. Assuming that the defenders were imbued with the will to resist, the secret of the success of the assault detachment lay in thoroughly trained personnel, adequate equipment, careful reconnaissance, thorough planning and rehearsal—and, finally, in the precise coordination of the participating arms.

The story of Eben-Emael was repeated, certainly several and probably many times, as the German divisions broke through one after another of the fortified lines in the Low Countries and northern France. However, although these assaults on fortified areas may have been the most spectacular of the activities of the Bahnbrecher, they were not his only ones.

RIVER CROSSINGS.

For example, there were many waterways to cross—the Meuse, the Albert Canal, the Scheldt, the Lys, the Somme, and others. Indeed, on its approach march, the assault detachment whose operations at Eben-Emael have been described found the Meuse bridges at Maastricht destroyed. The crossing was forced in the face of the enemy, under the cover of fire from the anti-aircraft batteries, and possibly with the help of parachutists landed on the far bank. Later in the morning other engineers constructed pontoon bridges across the river.

Throughout the advance through the Low Countries and France bridges appear to have been thrown quickly, almost precipitously, across the waterways. Evidently the *tempo* of the classic river crossing was stepped up greatly, and perhaps some of the classic requirements were brushed aside. The part which parachute or air units may have played in establishing bridgeheads is not yet discernible. However, it is clear that most of these crossings were made in the face of an enemy whose front was constantly being penetrated, and whose flanks constantly faced envelopment. Probably the river lines were not defended in the classic manner.

An account of a crossing of the Vistula River during the Polish campaign* reveals what may have been typical "blitz-crossing" practice. The crossing was made during the advance of the Fourth Army eastward across the corridor. The advance had begun at dawn, September 1st, and by the night of September 3rd had reached the Vistula in the area Graudenz-Kulm-Bromberg. During the night of September 3rd, the ferrying of infantry units with supporting weapons had been begun south of Kulm. The Poles were resisting, but apparently not in force. At about this time (night of September

* Vierteljahresheft für Pioniere, No. 4, 1939.

3rd), corps orders were given for the construction of a division-load pontoon bridge in the vicinity of Kulm.

The operation was under the command of an "engineer regimental staff," to which had been assigned, by the corps, the three motorized battalions and the nine bridge-trains involved.

Reconnaissance during the night of September 4th-5th had shown the existing ferry site at Kulm to be the most advantageous site for the bridge. The river there was about 1,000 fect wide, with a maximum current of about three feet per second. Construction was to be by the method of rafts, the rafts to be built at three different points. The assembly of the bridge proceeded in the face of only desultory resistance. There was apparently no enemy artillery fire and no enemy air activity. Under these conditions the bridge was completed in about ten hours—a fair, but by no means remarkable, performance.

Rumours of bridges tailor-made for specific locations and ready for insertion in the slot should probably be discounted. The very fine pontoon and trestle equipage of the Germans, complemented by the thoroughly trained engineer units, is tailor-made for any stream. However, it is true that, due partly to the restricted authority given the Allied bridge guards, many bridges were captured intact. Meanwhile, conjecture as to the methods used in getting superheavy tanks across the stream should await confirmation of the reports that such tanks were actually used.

BARRIER OPERATIONS.

So far, there have been received no reports of any large-scale use of barrier tactics on the part of German engineers during the recent campaigns. From the German viewpoint, the campaigns emphasize the overcoming of, rather than the erection of, obstacles. However, it is well not to let this obscure the fact that the German engineers were prepared to supplement their Bahnbrecher work with equally efficient *Bahnstörer* (barrier) work, had the occasion demanded.

German barrier tactics further illustrate the intimate co-ordination between engineers and other arms. The so-called *Sperverbande* are detachments made up of engineers, infantry, machine-gun units, anti-tank units, and perhaps anti-aircraft units. Such a detachment is prepared to take over an area, convert it into a *Sperrgebiet* (obstacle zone), and so deny it to the enemy. It is a case of co-ordinating the obstacle-power of engineers with the fire-power of the other elements of the detachment.

As an indication of German thought on the possibilities of barrier tactics, I may cite the German belief that a gap like the one that opened between their First and Second Armies at the Marne in 1914 could be closed for an adequate time by Sperrverbände. During the recent invasion of France it appears that as the Germans drove the great wedge from Sedan to Abbeville, the French forces south of the Somme everywhere were on the defensive. Had these forces been able to attack, it is probable that we would have had accounts of German barrier operations designed to resist the attacks. Perhaps, even as things were, it will be learned that the Germans, taking as always no more chances than necessary, protected their lengthening flanks by barrier zones.

MOPPING-UP OPERATIONS.

In Poland, considerable resistance was encountered in the towns and villages. Many of these were organized for defence, with the streets barricaded. An important mission which frequently fell to engineer assault detachments was the capture and clearing of such barricades, and the mopping-up of resistance in the buildings. The technique here involved was similar to that described for the reduction of fortifications. Houses were attacked and reduced chiefly by means of explosives. Barricades usually were outflanked by parties which had advanced from house to house.

ROAD MAINTENANCE.

The German emphasis on the combat aspects of engineer operations has sometimes been discounted by sceptics who have said in effect, "That's all very well for peace-time training, but when the action gets under way the most important engineer job will be maintenance of roads." The German idea has been that road maintenance is an operation undeniably important; but that it is one which requires little technical skill and which, therefore, should not consume the time of trained combat engineers. Events in Poland and in western Europe can be sited to illustrate the German thought on this matter.

It is necessary here to make reference to the German Arbeitsdienst (Labour Service). This is an organization into which all German youth are conscripted at about the age of eighteen. They serve in the organization for six months, and then begin their compulsory army service. The Labour Service is semi-military in character. Since its establishment, more than two and one-half million youths have passed through the Arbeitsdienst and into the Army (the physical training received in the Arbeitsdienst explains in some measure the remarkable marching and other physical performances of the German troops). The Arbeitsdienst has continued to function throughout the war; this despite the fact that sixty per cent of its officers have been called into the Army.

During the Polish campaign more than 500 companies of the

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Arbeitsdienst (each perhaps 200 strong) were in the field. They were employed primarily on the maintenance of roads. Meanwhile, special units of skilled and semi-skilled labour were at work on bridges. It appears that all this work was done under the control of engineer staffs; but regular engineer-troop units were not much involved.

At the time of the Polish campaign, additional units of the Arbeitsdienst (perhaps 300 companies) were working on the construction of the Westwall. There they worked in conjunction with the Organization Todt, which takes its name from the civilian engineer who built the great motor highways of Germany and later played an important part in the emergency task of constructing the Westwall.* The Organization Todt consisted of skilled, semiskilled, and unskilled labour, more or less conscripted from all parts of Germany.

It appears that both the Arbeitsdienst and the Organization Todt were employed on the maintenance of bridges and roads during the operations on the Western Front. Commenting on what it calls the remarkable success of German supply operations during the campaign in Flanders, the semi-official army publication, *Militär-Wochenblatt*, states: "Elements of the German Arbeitsdienst were pushed forward to the very front. The Organization Todt everywhere worked unflinchingly on roads and bridges." Again it is clear that the regular engineer units were able to devote themselves chiefly to missions strictly combative.

There always is to be kept in mind the fact that the German Army was designed for a specific enemy in a specific theatre of operations. This thought enters the picture when we are tempted to endorse unreservedly the German doctrine of a *pioneer*, as against an *engineer*, corps. We must ourselves keep in mind the possibility of operating under widely varying conditions—conditions where water supply might be more important than assault tactics, where labour battalions from the interior might not be available on call, or where our own air superiority might not be such as to make of camouflage a superfluous art. As somebody remarked on that last sodden day of the Third Army manœuvres in Louisiana, "I'd like to see a panzer division blitzkrieging over *this* terrain."

There is one conclusion, however, which is incontestable (and obvious). It has to do with the intimate co-ordination which must exist between members of the combat team. The German blitz campaigns have demonstrated this fact more forcibly, perhaps, than it ever before has been demonstrated. And as a corollary fact, the campaigns have demonstrated that the engineers are now an élite member of the team.

^{*} The Westwall was designed, and its construction was supervised, by engineers of the Fortifications Branch of the *Pionierkorps*. The engineers of the Fortifications Branch are specialists whose operations are not pertinent to this article.

THE PRINCIPLES OF COMBINED OPERATIONS.

By BRIGADIER W. G. S. DOBBIE, C.B., C.M.G., D.S.O. (now Lieut.-General, Colonel Commandant R.E.)

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I.—GENERAL REMARKS.

I. In any war in which the Empire may be engaged, in the future as in the past, Sea Power must play a very important part. It is not too much to say that in nearly every case it will be, ultimately at any rate, the decisive factor. In any case, and at all stages, it will be an invaluable weapon, and it would be criminal folly not to make the fullest use of it. But we shall not be able to do so unless we study and master the principles underlying its application.

Frequently in the past victory has attended our arms owing to the fact that we have appreciated the value of sea power more clearly than our enemies have done. But there is, perhaps, nowadays a tendency to suppose that the altered conditions of to-day (e.g., the advent of the Air Arm), have affected the validity of this old-established principle. This fallacious idea constitutes a definite danger and calls for careful study of the subject on the part of all persons concerned with the defence of the Empire.

2. Sea power may be used to our advantage in three ways :---

- (a) By insuring the uninterrupted flow of all necessary supplies to the various portions of the Empire.
- (b) By interrupting the enemy's supplies from overseas.
- (c) By threatening him or attacking him at any place on his seaboard that we may choose.

3. Combined operations may be necessary to put any of the above into effect. (a) and (b) may at first sight appear to be matters for the Navy alone, but in reality the Navy cannot carry out its functions without the assistance of the Army, as history has shown over and over again. The Fleet cannot function without safe harbours conveniently situated for the theatre of its operations. The necessary harbours may have to be seized and in any case protected. It is true that in the Great War the Navy in some cases provided their own protection on land, notably at Scapa Flow and St. Helena. But the circumstances then were exceptional, as the Army was so

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fully employed in the main theatre that it was unable to spare men or material for the defence of these additional harbours. But usually this duty will fall upon the Army, and will in some cases require a military undertaking of considerable magnitude, involving at the outset a difficult and tricky combined operation.

4. It might also be desired to seize some enemy territory on which to establish an air base within effective range of vital objects, or, again, to establish a military base with a view to aggressive military action. But for whatever purpose we use our sca power, *i.e.*, whether for subsequent naval, military or air operations, a combined operation of some sort will be necessary, and for this reason the principles should be studied. If we have to confine ourselves to landings at places where we need expect no opposition, our choice will be very much restricted, and we will not turn to best advantage the weapon placed in our hands by sea power. But if we are prepared to consider landings at any place on the enemy's seaboard, and despite any opposition which may be encountered, we will be using our sea power to the full and will be keeping the enemy guessing, and we will be forcing him to make numerous detachments with all their attendant disadvantages. But such landings are difficult operations of war, and require much previous study before they can be made possible. However, in view of the great strategic advantages which may be gained, the study of this difficult subject is well worth while, and is, indeed, incumbent on all the three Services.

II.—THE UNDERLYING PRINCIPLES GOVERNING THE SUCCESSFUL CONDUCT OF COMBINED OPERATIONS.

5. If a combined operation (e.g., a landing on enemy coast line) is to have a reasonable chance of success, the element of surprise is all-important. This can only be achieved if the strictest secrecy in preparation is observed and the greatest rapidity in execution is assured by careful and methodical foresight.

As regards secrecy, it is of three kinds :---

- (a) Secrecy as to the fact that the expedition is contemplated at all.
- (b) Secrecy as to the proposed place of landing.
- (c) Secrecy as to the time.

(a) is, of course, far the best of the three, but in view of the considerable preparations required it is very difficult to attain. But much can be done in this direction if care is taken to prevent irresponsible and light-hearted acts by one or other of the fighting Services.

In the case of the Dardanelles untold harm was done by the original naval attack, which drew the attention of the Turks to the fact that we were much interested in that part of the world. It is, of course, acknowledged that in this case a combined operation was not at that time contemplated. But the fact remains that the naval action infinitely increased the difficulties of the Army when it was later decided to put it ashore. In those days there were only two independent fighting Services. Now there are three, and this will not render a premature disclosure of our intention any less likely. It points to the necessity of a central authority which will be able to control the action of all three Services, so as to conform to the general plan.

6. Although preparations may not be hid, it is in some cases possible to turn this fact to our advantage, by playing on the enemics' fears and causing them to make detachments, when we have actually no intention of making a landing. Both we and the Germans did this to the other with some success in the War.

We may even go so far, perhaps, as to adopt second degree methods, and to induce the enemy to think that our preparations are so obvious that they are clearly intended to deceive him into imagining that we intend to attack when actually we have no such intention, and so on *ad infinitum*.

7. Secrecy as to place must be insisted on, even when the fact that we propose to effect a landing cannot be hidden. This can be achieved by allowing no attention to be drawn to the place selected by premature reconnaissance by sea or air (unless our warships and aircraft have been regularly operating in the vicinity—in that case their sudden disappearance might rouse the enemy's suspicions), and by making reconnaissances at other places where a landing is not intended. In this connection, the principle should be followed that a secret should only be disclosed to those persons who need to know it, and to no one else. It is, therefore, unnecessary to inform all of those concerned in the reconnaissances above-mentioned that their reconnaissance is really a blind. It will be much more realistic if they think it is the real thing and so the more likely to deceive the enemy.

8. Secrecy about the place selected is, however, not always possible to ensure. It will frequently occur that the choice of possible landing places is so restricted that there will be little doubt in the enemy's mind where the landing, if attempted, will be made. As a preliminary to a big military expedition it will obviously have to be within reasonable distance of some organized harbour, which will be required as base for the main force. In such a case secrecy as to the time and date of landing is of absolutely vital importance. The time chosen need not be confided beforehand but to very few.

9. Historical examples illustrative of the above points are not wanting.

At the Dardanelles in the original landing at Anzac and Helles, the secret of the fact, place and time of landing was not preserved,

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and the great difficulty we had in forcing our way ashore is directly attributable to this cause.

At Suvla, however, the sccret was well kept, and the actual landing presented little or no difficulty. Difficulties occurred later, but were due to entirely different causes.

10. Another essential element for success is forethought.

In view of the necessity of ensuring surprise, and of the speed at which operations once commenced will have to be carried through, it will not be feasible to make elaborate plans on the spot. The plans must, so far as is possible, be thought out beforehand and the probable requirements anticipated. In many respects it is possible to go into greater detail in the plan of a landing operation than in others. The scope of the operation in its initial phase is limited, and particular units have well-defined and comparatively simple tasks to carry out. Forethought can do wonders in this respect, and the learning of its part by each unit can be effected in comfortable conditions, and not under fire.

II. One of the main difficulties in combined operations is that each service is working with and is in a special degree dependent upon the other two Services, whose work, customs and methods are to some extent unfamiliar. This will especially be the case between the Navy and the Army. Normally we each have to do a job which is quite independent of the other Service, but here we are suddenly brought into such intimate contact that we have to carry out one of the most delicate operations of war in the closest co-operation with each other.

Moreover, we are each doing something for which we were not primarily intended. The Navy is organized, designed and trained for fighting warships on blue water. Its very guns and ammunition are by no means ideal for dealing with hostile troops on land, and, although the ships can carry a certain amount of ammunition more suitable for this purpose, yet this will be limited in quantity, as they must always maintain a sufficiency of proper naval ammunition to enable them to carry out their true role against enemy ships. The flat trajectory of the gun, moreover, is a drawback that can hardly be overcome, as was shown in the Dardanelles campaign.

The Army, moreover, is designed to move and have its being on shore. Put it into boats and it is out of its element. A great feeling of helplessness is likely to pervade the military force in these circumstances, to say nothing of sea-sickness.

All this proves that the more each Service can sympathetically understand the possibilities and limitations of the other, the more likely it will be that a good plan will be made ; and the more practice each Service can have in the abnormal tasks that will fall to its lot, the higher will be its confidence and its morale when the time comes to put the plan into execution, and the greater the probability of success. 1940.]

III.-THE MAKING OF THE PLAN.

12. It may now be helpful to discuss a landing operation of a particular type, under the following headings :---

- (a) Plan.
- (b) Preparation.
- (c) Execution.

We will imagine that a military expedition of some size has been decided on against a hostile country, and that the approach is to be by sea.

Such an expedition will obviously require an organized port for a base, and the acquisition of such a port will become the first main objective. It may be assumed that the port selected is defended by Coast Artillery and that a direct attack on it from the sea would, even if possible, be costly, difficult and tedious, thus giving the enemy time to mass his troops to resist our attack. It is, therefore, decided to attack and capture the port from the land side and to this end to land a military force of a suitable size at some convenient point on the coast with the object of—

- (a) Establishing itself ashore.
- (b) Seizing the port.
- (c) Enabling the rest of the expedition to land at the port.
- 13. The choice of the landing place will now be considered.

The military will select a certain locality as being suitable to their needs, *i.e.*,

- (a) At a suitable distance from the port (not too far and not too near) and with a possible line of approach to it—water supply, etc.
- (b) Not likely to give the enemy strong positions on which to oppose the landing or delay the subsequent advance on the port.
- (c) Enemy's positions can be dealt with by guns of supporting ships.
- (d) Suitable bridgehead positions for the covering force to seize and hold.
- (e) Place in the area from which our aircraft can operate.

14. The naval staff now consider this locality from the naval point of view, and will decide whether it is feasible in the following respects :---

- (a) Suitability of beaches—depth of water—currents, etc.
- (b) The distance the transports will have to lie from the shore.
- (c) The positions of covering warships.
- (d) Effect of bad weather, etc., etc.

It may be necessary to modify or even discard the military general

proposals, but it will, of course, be understood that the Army being the predominant partner in this case, the other two Services will naturally consider themselves the servants of the Army for the time being, and do their very best to meet the Army's requirements.

15. Having then decided in general terms on the place of landing, the next point is to decide the strength of the landing force.

This will be divided into two parts-

- (a) The covering force.
- (b) The remainder.

The former is, of course, the more important of the two, as it may have to land in face of opposition—a difficult and hazardous operation at all times.

The strength of the covering force will depend inter alia on :---

- (a) The expected strength of the enemy.
- (b) The position it will have to seize and hold as a bridgehead.
- (c) The length of time it will have to hold this until supported by the remainder of the force.

16. The composition of the force will also have to be decided. The following are some of the considerations which will dictate the composition :---

(a) Cavalry would be most useful for exploiting surprise and seizing important tactical localities inland, but they certainly could not be carried in the first flight, and their transport to the beach and subsequent supply present considerable difficulties.

In fact it may be assumed that with the covering force horses must be reduced to an absolute minimum.

So one can expect at most only a very small force of cavalry with the covering force, and that not with the first flight. The size of the force of cavalry which it will be possible to allot will prevent it being of much use for offensive purposes, and it would therefore be employed for reconnaissance and intercommunication.

(b) Artillery. Some artillery support can in the first instance be given by the guns of warships, but as the infantry progress inland this will become less and less effective owing to the flat trajectory of the naval guns, and mobile land guns or howitzers will be needed.

If it were not for the difficulty in landing and supplying horses in the initial stages, it is probable that light artillery (3.7" howitzers on pack) would be the most suitable weapon. Failing that, some form of tractordrawn artillery will probably be the most satisfactory, provided the nature of the country and the landing facilities admit of it. But it may well be necessary to accept the disadvantages of horses and detail 3.7" howitzers on pack to the covering force.

- (c) Engineers. A good-sized force of this arm will be required for the following purposes—
 - (a) Communications and removal of obstacles.
 - (b) Water supply.
 - (c) Improving landing facilities on the beach. Some should land with the first flight.
- (d) Infantry. The strength depends on the opposition to be expected and the extent of the bridgehead to be secured.
- (e) Tanks. These would be invaluable, especially if machine-gun opposition is likely to be encountered at the moment of disembarkation. It is desirable that in these circumstances tanks should be the first to go ashore. But this presupposes a suitable form of lighter to convoy the tanks ashore, and this does not exist. There is no doubt that if this difficulty were overcome tanks would be eminently suited to this role. But if this is not possible, they could no doubt be put on shore after the leading troops have cleared the beaches, and would be of the greatest value in later phases, especially if the enemy are likely to produce tanks.

During the War in 1917 this difficulty of landing tanks in the face of opposition was overcome by the Bacon Pontoon (see *The R.E. Journal*, June, 1924, page 190), but the circumstances under which it was to be used were very exceptional and not likely to obtain in other landing operations.

- (f) Supplies and ammunition must be put on shore, and medical arrangements made for dealing with wounded.
- (g) It might be desirable that cyclists should be landed with the first flight. It must, however, be remembered that it is not every terrain which would suit them. In Gallipoli, for instance, they would have been of no use. Moreover, there are no cyclist units in the British Army now. So that if a cyclist unit were required it would have to be extemporized. But subject to these considerations, in suitable circumstances there is no doubt that they would be of the greatest value and take the place of the cavalry, which are not likely to be available, as we have seen.
- (h) As regards aircraft, these will have to operate, to start with, from carriers until arrangements can be made for them to come ashore. They obviously cannot land with the covering force.

17. Having decided on the strength and composition of the covering force, it is necessary to consider and decide—

(a) the places at which the component parts go ashore, and (b) the order in which they go ashore.

The greater the number of landing-places selected for the leading troops the greater the chance of surprise, since the enemy cannot watch everywhere, and an advance from one beach may ease the opposition at another. There is, however, a drawback to the multiplication of the number of landing-places, since it dissipates a force and renders control more difficult. A balance must consequently be held between the two conflicting considerations. It is suggested, however, that it would be wiser to err in favour of the former than of the latter, since the difficulty of control can to some extent be overcome by careful forethought and rehearsal.

The decision as to the place and order of landing of the various units will, of course, affect the way in which the various vessels carrying the landing force from the advanced sea base are loaded. Here naval considerations have to be taken into account, and it may be necessary on account of these to modify the military requirements. Thus we see that in order to arrive at the number, class and size of the ships to be procured for the expedition, it is necessary to work backwards from the tactical plan for the covering force landing on the enemy's coast.

18. Having settled the details of the covering force, similar, though less complicated considerations will be necessary for the remainder of the subsidiary landing force.

The fighting troops must be landed without any delay as soon as the covering force has established itself ashore. Time is now allimportant, since not only will the covering force require support, but the whole force must move as rapidly as possible to seize the port before the enemy can recover from his surprise and bring up his reserves.

In this force it will be necessary to make provision for administrative units and personnel who will be required not only to serve the force advancing on the port but also, when the latter has been seized, to make the necessary preparations for the arrival of the main force.

19. The choice of the time at which the first flight should reach the shore is bound up with many considerations both tactical and naval. The choice lies between—

- (a) Complete darkness.
- (b) Dawn.
- (c) Broad daylight.

In (a) and to a lesser extent in (b), the approach of the flotilla is

less likely to be observed, and the chance of a tactical surprise correspondingly increased. Further, even if complete surprise is not achieved, the hostile machine-gun fire will probably be less effective. But the naval difficulties in carrying out a landing at this time are very considerable. Without elaborate preliminary preparations (which conditions of secrecy may rule out) it is possible that mistakes may be made and that the troops may not be landed at the places intended. If that should occur considerable confusion and delay would inevitably result.

Landing in daylight, of course, does away with many of the naval difficulties, and the actual process of disembarkation if unopposed is likely to be much quicker.

If there is opposition the covering fire from ships is likely to be more effective against such targets as may be visible. But on the other hand the enemy's observers will give early warning of the approach of the expedition, enabling preparations to be made for its reception. Even if troops cannot be brought up to resist the actual landing they can probably be disposed so as to dispute the subsequent advance, and aircraft may be able to attack the landing force before it is clear of the boats. In other words the advantages of surprise are lost or greatly discounted, and, as has already been pointed out, surprise is the most important condition of success in an enterprise of this nature, and, generally speaking, it is obvious that in spite of some advantages a landing in unobscured daylight will, if opposed, be a very hazardous and costly proceeding and would rarely be justifiable.

Finally, in considering the time of landing, it must be remembered that the state of the tide is a very important factor, since the first flight will probably require to land on the rising tide.

20. The possibility of the use of smoke to cover the landing of the first flight must now be considered. To some extent it can take the place of darkness, and has most of the advantages of the latter without all the disadvantages.

It has, however, certain special drawbacks peculiar to itself. These latter may be enumerated as follows :---

- (a) It is dependent on the strength and direction of the wind.
- (b) It can only be maintained for a limited period.

Smoke may be produced by the following means :---

- (a) Smoke shells.
- (b) Aeroplanes.
- (c) Small naval craft.

(a) need not be considered as warships do not normally carry smoke shells, and in any case this means is not in the circumstances very convenient, since the positions to be screened may be uncomfortably close to where the troops will be landing, and the fail of the large naval shells might incommode the troops.

(b) Experiments have been carried out with considerable success in dropping smoke screens from aeroplanes. These screens are quickly and accurately laid, are very thick while they last and can be repeated as required.

(c) was often carried out in the War for naval purposes, and was quite efficient. It is obvious, however, that they can only be used to cover a landing where there is an on-shore wind. The strength of the wind is also of great importance, as it must neither be too strong nor too weak. Thus the restrictions regarding the use by this means of smoke are considerable, and there can be no certainty that the conditions prevailing will allow the smoke screen to be produced by this means at all.

The formation of the smoke screen by aeroplane is somewhat less dependent on the weather conditions, and that from smoke shell still less again.

If satisfactory arrangements for a smoke screen can be made many of the disadvantages of a daylight landing cease to apply, though it must be noted that the grave drawback of loss of strategical surprise referred to above will still obtain.

21. Special arrangements for anti-aircraft defence must be made in the plan.

The best anti-aircraft defence is by means of aircraft, but it must be realized that the invading aircraft are at first likely to be working at a great disadvantage in comparison with the aircraft on the other side. The former will most likely have to operate from carriers, while the latter enjoy the advantages of a land aerodrome. Even if the attackers have been able to seize an island conveniently situated, the facilities established there can only be of an extemporized order, while if preparations are made beforehand the element of surprise is lost. The chances of having a well-equipped aerodrome within easy operating distance of the point of attack will be remote.

It can be assumed then that the number of aircraft available in the first stage will be strictly limited, and it is probable that this number will be mostly required for reconnaissance purposes and will not be available for fighting.

In any case the amount of protection which our aircraft will be able to afford to the first flight against hostile aircraft will be meagre, and other means of protection will be needed.

22. So far as the military force is concerned, the anti-aircraft problem may be divided into three stages :---

- (a) When the troops are on board ship.
- (b) When they are being ferried to the shore.
- (c) When they are on shore.

(a) is the entire responsibility of the Navy, and so, strictly speaking, is (b). But this is the time when the danger to the troops is the greatest, and it is desirable that the efforts of the Navy should be supplemented by the troops themselves.

Any air attack against the tows is likely to be delivered from a low height, and the aeroplanes will be within easy small-arm range. Arrangements must be made in consequence for small-arm fire to be instantly forthcoming from the tows in the event of air attack. Antiaircraft light automatics should be mounted in the tows and operated by military or naval personnel as most convenient, while some of the troops in each boat should be detailed to use their rifles against hostile aircraft. The volume of fire thus generated is bound, at any rate, to affect the accuracy of the hostile attack and is likely to inflict loss on the enemy. It is, moreover, better for men who are being attacked from the air to fire back rather than sit passively hoping they will not be hit.

23. It is realized that in some quarters the effect of an air attack is valued at so high a figure that it is considered that, unless the attacking force has virtual command of the air, a landing in the face of hostile air attack will be impossible. It has been shown that the landing force is most unlikely to enjoy that position, as in the air they will be at a disadvantage to start with. Are we then to assume that the landing cannot be carried out on this account? It is suggested that our answer must be "no." We are getting more and more confidence in our preventive measures, and we must ensure that they will become more efficient still. We must also remember that, if the general plan has been well laid, provision will have been made for mystifying and misleading the enemy, and this will, it is hoped, affect the numbers of aircraft available to resist the actual landing, as well as their employment.

When once the troops have got ashore, they become less and less a target for aircraft. But immediate steps must be taken to protect the beaches from air attack, and, to this end, A.A. light automatics must be set up at convenient places without delay.

24. Of the points to be embodied in the plan we have still to consider the following :---

- (a) Reserve for the covering force.
- (b) Intercommunication and position of headquarters.
- (c) Administrative arrangements.

As regards the reserve, it may either be landed at a pre-arranged place immediately the leading waves have gone ashore, or it may be kept afloat and put ashore at a time and place required by the developing situation. There are pros and cons for each method. The former is simpler. Everyone knows where the reserve is, and this will probably be the best plan if the chances of serious resistance to the actual landing are not very great.

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If the landing-places are mutually cut off from each other, or if the likelihood of a successful landing at all places is slight, it may be preferable to keep the reserve afloat, so that the commander of the covering force may use his reserve to influence a situation which he cannot foresee. But in this case it must be borne in mind that the landing of the reserve may be very difficult. The enemy will have been thoroughly aroused and his artillery and aircraft may be able to inflict much loss on the reserve as it approaches the selected beach. The smoke which perhaps was used to cover the approach of the first flight may no longer be available and altogether the approach to the shore may become a highly unpleasant trip. In any case, it will probably be useless to use the reserve to force a landing at a place where the leading troops have failed to gain a footing ashore.

25. The position of H.Q. for the covering force is to a great extent bound up with that of the reserve, since the two should be adjacent to each other. It is, of course, undesirable that the H.Q. should become involved in a dog fight on the beach, but if it is possible to decide beforehand where and when the H.Q. will be established ashore, the problem of communication is enormously simplified. This problem is at best a remarkably difficult and complex one.

- (a) The three Services have to be kept in constant and intimate touch.
- (b) The covering force commander has to be in touch with his subordinates, superiors, and colleagues of the other Services at all times, *i.e.*, whether he or they or some of them are ashore or afloat.

The importance of this matter cannot be too clearly recognised, and it is hardly too much to say that the whole success of the operation may depend on a successful solution of the intercommunication difficulties. However great these difficulties may be, they *must* be overcome.

It is also necessary to provide more than one means of communication, so that if one fails, as is very likely to be the case, touch may still be maintained.

26. Last, but by no means least, there are the administrative problems. Of these, water may be so important as to be almost decisive, as it was at Suvla. The site of a suitable water supply may, in fact, become the chief tactical objective of the covering force.

Then there is the problem of the evacuation of wounded. Are the wounded of the first flight to be sent back in the boats which are required to bring ashore reserves as soon as possible ? If so, they are apt to cause delay, when time is precious. If not, special arrangements must be made for their evacuation.

Supplies and ammunition present difficult problems. If for any reason, e.g., change of weather, presence of enemy submarines, etc.,

the covering force has to be left isolated for a time, reserves of all kinds of foods, water, ammunition, engineer material, medical comforts, etc., must be available for them. These must, therefore, be landed at the earliest moment, so as to make sure that they will be available if required.

IV.—THE PREPARATION FOR THE LANDING.

27. So much for the plan. We can now pass on to the preparation.

This will chiefly consist of rehearsing such parts as can be rehearsed, and in making sure that every sub-unit and, indeed, every man, knows what is required of it or him. If it is possible to do so, it is very helpful to make a model of the various beaches, so that the men may see with their eyes their immediate objectives as soon as they have landed. The more this can be done the better, as it will eliminate confusion at a time when that would be most dangerous.

A note of warning, however, must be sounded. This method is excellent if the troops are actually put ashore exactly where they expect to be. But if there is any chance of a mistake occurring owing to darkness, currents, etc., and of the troops not landing where they expected (as occurred in Gallipoli) they must be prepared to act independently of their model practice and deal with the situation as they actually find it. They must, therefore, be taught the principles governing their action as well as the special details.

The preparation of the model, however, may present great difficultics, especially if previous reconnaissance by air or sea is forbidden, and this, as has already been shown, will usually be the case.

28. Then pratice in boatwork and in rapid disembarkation is important. It is astonishing how this operation can be speeded up with practice. The naval personnel and the military units who will be associated on the day of landing should carry out their practice together, so that they get to know each other and have confidence in each other.

Practice in intercommunication between the Services must also be arranged, and especially in connection with the direction of the artillery fire of the ships detailed to support the troops ashore. This is an exceptionally difficult matter, but it is of the utmost importance. Instances are not wanting of the most unfortunate results arising out of unsatisfactory communication between the forward troops on shore and the supporting ships, and these instances will, no doubt, recur in the future unless the most meticulous care is taken in the arrangement of intercommunication services.

29. It is not necessary to do more than mention the necessity of organizing the necessary naval and military personnel at the place where the responsibility of the former ends and that of the latter

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begins. It is perhaps permissible to remind ourselves that the success of the landing largely depends on the harmonious working of the two parties, and everything which will tend to this harmonious working should be done. The longer the personnel of these two parties can have to get to know each other personally before the actual landing, the more likely is their co-operation to be harmonious and effective.

V.-THE EXECUTION OF THE PLAN.

30. The plan has now been made, the troops have had it explained to them, and they have rehearsed and practiced their parts as much as possible. All that can be done beforehand by forethought and care to make the operation a success has been done. It now remains to carry it out.

If one thing in the execution of the plan is more essential than another, it is the determination to succeed coupled with the most vigorous action. These qualities are necessary in any operation of war, but they are superlatively so in the type of operation under review. A study of the operations at Suvla makes this abundantly clear, as the lack of these qualities in some cases deprived us of success.

It is probable that at any rate some degree of surprise will have been achieved if the plan has been well laid. The enemy will, it is hoped, be uncertain where the attack will come, and will consequently not be able to commit his force until he knows. The opposition to start with is likely to be provided only by a screen of observation troops, and this opposition should be overcome without undue difficulty. There will then be a brief respite until the enemy's reserve can be brought into the picture—and it is of vital importance that this respite shall be made full use of. During this period it will be possible, in all probability, to secure tactical features without opposition, which later could only be secured as the result of bitter fighting. The determination to push on regardless of everything and to secure these features without delay must be impressed on all from the top to the bottom. That is the chief requirement.

31. How can this be assured ? History shows that there are many difficulties to overcome. The troops are weary, they are disorganized, units are mixed up, they have run out of water, etc., etc. These difficulties can to some extent be met with by the care bestowed on the planning and preparation beforehand, but success will be won chiefly by instilling the right spirit into the troops beforehand, and making them understand down to the last private that the success of the operation and their own security depend on their taking full advantage of the lull that is likely to occur immediately after the landing. Officers and N.C.O.s will be called upon to display the highest qualities of leadership at this time. 32. Having secured the desired tactical localities, immediate steps must be taken to prepare them for defence. Machine-guns must be handled boldly so as to cover the approaches to these places; guns, as soon as ashore, must be posted with the same object, and communication established with the covering warships so that the fire of the latter in support of the troops ashore may be suitably controlled. But equally important is the landing of reserves. These must land practically on the tail of the first flight, provided there are enough boats for the purpose. The presence of an organized and fairly fresh body of troops in the early stages will give an impulse which may be badly needed and will produce results out of all proportion to their strength—and therefore every effort must be made to make them forthcoming when required.

33. It is also important to keep the beaches as clear as possible after the first flight has landed. These beaches are likely to become targets for hostile guns and aircraft, and are thus apt to be decidedly unhealthy. Every boatload when landed must immediately clear the beach.

Some personnel required for handling stores must, of course, stay there, but their numbers should not be increased by a single unnecessary man.

34. As more troops are disembarked, ground should be seized further and further afield, subject, of course, to due consideration for the security of the advanced detachments. The force landing behind the covering force will want elbow room in order to prepare for its own role, *i.e.*, the advance on and the capture of the adjacent hostile port.

The plan for this advance must be made and put into execution as soon as possible. The enemy must be given the minimum of respite in which to organize his defence or prepare a heavy counter-attack. A good deal of the plan can be thought out beforehand, but it cannot be put into final shape until the covering force has got ashore. The positions secured by the covering force, and the ascertained positions, strength and morale of the enemy will, of course, affect the plan.

35. No mention has, so far, been made of the use of gas, but the possibility must not be overlooked that the enemy might see fit to use a persistent form of gas to protect his port by denying certain lines of approach to an invader, or of restricting the number of places where landings could be attempted.

Early imformation on such a matter would be of vital importance, since such action on the enemy's part would profoundly affect the plan of operation, and in all cases where such a possibility exists, the plan must be capable of adaption in order to deal with it.

The chief safeguard against this eventuality is obviously secrecy as to our plans. The enemy is not likely to impregnate a large area of his territory with mustard gas—unless he has reason to suppose it will be of real value. Secrecy as to the intention of landing somewhere is, of course, highly desirable, but secrecy as to the actual place of landing is essential.

36. The desirability of appointing a supreme commander for an expedition of this sort who will control generally the actions of the three Services, has already been hinted at. The question is one of the greatest difficulty, but it is none the less an extremely important one, and one which must be faced. History is full of proofs of the importance of such an appointment, and perhaps the military are more interested in its materialization than the other two Services, since any adverse consequences arising from the lack of a supreme commander usually fall on the Army. Now that there are three Services instead of two, the matter is all the more important.

37. In the foregoing paragraphs an attempt has been made to indicate the factors which influence the preparation of the plan by the responsible authorities. No attempt has been made to enlarge upon these various points, though each must be studied carefully by all who may be concerned in this most difficult operation.

To sum up :---

In a combined operation such as a landing on an enemy's coast, the following are the essential requirements :---

- (a) One supreme commander.
- (b) Surprise. Complete if possible, but at any rate partial.
- (c) A complete and sympathetic understanding between the three Services.
- (d) Foresight and meticulous care in the preparation of the plan.
- (e) The utmost dash, vigour and boldness in its execution.
- (f) The greatest care in all administrative preparations, on which the whole success of the venture may well depend.

OPERATION OF FIELD LIGHTING SETS, 4 KW.

By 2ND-LIEUTENANT T. C. NUTTALL, R.E. (S.R.)

To commence this article, may I first explain my own personal experience leading up to the actual operating and maintenance of these sets.

Going out to France in early October, 1939, as E. and M. Officer in an Army Troops Company, I did have an opportunity of examining these sets that were taken with us. In March, 1940, however, I was posted as E. and M. Officer to a C.R.E. attached to G.H.Q.

Being an electrical engineer, this job was most interesting. When the move into Belgium was made in May last, I was asked for by a Field Company to go up with them to assist in running these sets. They collected two 4-kw. air-cooled petrol-driven sets and our job was to light up Command G.H.Q. The unit itself did the P.A.D. work, including strutting and sandbagging cellars, and I had a small party wiring up the sets. The individual movements of G.H.Q. were too rapid to deal with in detail, but when the first move was made, I was detailed with a party of I lance-serjeant and 20 O.R's. from the Field Company to take two lighting sets and become attached to G.H.Q. At this point I would say that this small detachment chiefly consisted of Welsh miners, hardly any with electrical knowledge. Three 30-cwt. lorries were used to convey the party.

Our job of work was to establish a command post for G.H.Q.; this included sandbagging and strutting cellars and lighting the underground offices, etc. The longest stay in one place was three days and, therefore, it was necessary to be always prepared for a move and pack the sets up and carry as much wiring as possible.

We started off with the usual field lighting set wiring and a large amount of single V.I.R. cable, twin flex and spare lamp-holders, together with lamps. A point to note is that whereas English lamps are bayonet-cap fitting, the Belgians have screw cap, and therefore cannot be used in conjunction with the lighting set wiring. The sets were run alternately at each place we moved to, and this gave us time to overhaul and maintain efficient running. The maximum of any one set was 96 hours continuous running. Both sets ran well, except for slight trouble due to over-oiling.

I think the foregoing has set out briefly our job of work, and now I should like to give my own personal observations on the work.

First and foremost were the men. As I stated, they were nearly

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all miners and electrical work was obviously strange to them. The mechanical side was very well looked after by the drivers of the lorries, and one Sapper who had a good practical engineering knowledge. The over-oiling of the engine was due to the fact that when the men changed over shift, no information was given to the new shift that the engine had been filled up with oil ; although dip-stick showed full, the men were anxious to maintain the supply and topped up the engine again.

When we were on detachment, my first job was to call the men together and give them a friendly talk on the engine and electrical installation, explaining the connections of the field lighting, wiring, and also the use of V.I.R. cable, which incidentally came in extremely useful in running long leads overhead and tapping flex on where required.

À suggestion here might be of use to other users of the lighting sets, and that is that a heavy cable of approximately 7/044 Twin Cabtyre would be most useful in lieu of the 19/064 supplied, which was found to be too big to be of use in an emergency, and cannot be neatly packed without a small drum. The use of this 7/044 cable is to make good use of the distribution box, five-way type, as, in siting the generator, care must be taken to avoid fumes penetrating into the underground quarters, and also noise should be eliminated as far as possible. It would be an advantage if more flexible exhaust pipe could be supplied, or a connection suitable to attach the flexible pipe on to a standard size of galvanized tubing.

A megger is extremely useful for locating faulty lengths of C.T.S. cable; several minor faults occurred, due to the cable being bent round nails for support, instead of being tied to the nail.

In conclusion, I would like to say that I found by this experience that these Sappers picked up the work very quickly, and were very keen on fitting up the sets, and it was only necessary for me to give hints and tips whilst the job was in progress. Also I got to know the Sappers very well, and in times of stress each man knew exactly what was required of him and this resulted in good work and quickness which played a very big part in our job.

DISCHARGE FROM HYDRANTS.

By CADET OFFICER P. A. LAMONT, M.A., A.M.INST.C.E.

(Reprinted from Water and Water Engineering of July, 1940, by kind permission of the proprietors.)

THESE notes give particulars of a method which the author has used for the last five years to deduce the flow at the end of a *proposed* main extension from the flow at the hydrant nearest the end of the *existing* main; and they were written to enable the staff of the Cambridge University and Town Waterworks Co. to continue to use the method which has been very useful to the company, during the author's absence on military service.

The author points out at the outset that the experimental law for hydrant discharge (Part I of the notes) is very approximate. When, however, it is used in conjunction with the method for deducing the flow at the end of a proposed main extension (Part II of the notes), the results have been found by experience to be remarkably accurate (always within ± 10 per cent and usually within ± 5 per cent).

Quite apart from the hydrant discharge formulæ, the new type line charts for friction in cast iron and asbestos cement pipes should be generally useful for friction calculations. A full description of these charts is available at the University Library, Cambridge. (John Winbolt prize paper, 1933 :--Part II. The Use of Line Charts in Engineering.)

PART I.- APPROXIMATE LAW FOR HYDRANT DISCHARGE.

The square of the quantity flowing through a hydrant or other outlet in a system of water mains, subject at innumerable points to the normal draw-off to be expected in a waterworks distribution system, is proportional to the additional friction loss caused by that flow. That is :—

$$\mathbf{H} = \mathbf{C}\mathbf{Q}^2 \quad \dots \quad \dots \quad \dots \quad (\mathbf{I}$$

where Q = Discharge in gallons per minute.

- \ddot{H} = Additional friction loss caused by the flow in feet of water, *i.e.*, the difference between the static pressure at the hydrant before it was opened and the running pressure at the hydrant during the flow.
 - When the hydrant is running "full out" the running pressure is zero. Hence under "full out" conditions the static pressure (in fect of water) is equal to H.

C = A constant which may be determined for any particular hydrant by means of a single experiment with a hydrant flow gauge.

To Determine Constant " C."

Fix a hydrant flow gauge to the hydrant and determine the static pressure H in feet of water. Then set the flow gauge to determine rates of flow, open the hydrant full and determine the discharge Q in gallons per minute.

The constant "C" is given by the formula :---

Example (1).—The static pressure at a hydrant in the company's area is 40 lb. per sq. in. (92 ft. approximately) and the hydrant flow is 180 g.p.m. Find the constant "C."

We have :---

$$C = \frac{H}{Q^2} = \frac{92}{180^2} = \frac{92}{180} \frac{92}{\times 180}$$

= 0.00284.

Example (2).—At a certain hydrant in the company's area the discharge from a hydrant is 150 g.p.m. at a time when the static pressure is 50 lb. per sq. in. (116 ft. approximately).

Estimate the probable hydrant discharge at a time when heavy consumption has reduced the static pressure in the neighbourhood of the hydrant to 30 lb. per sq. in. (70 ft. approximately).

We have :---

$$C = \frac{H}{Q^2} = \frac{116}{150^2} = \frac{116}{150 \times 150}$$

= :00514

Hence for all flows and head conditions

H = 0.00514 Q²
When head = 70 ft.
70 = 0.00514 Q²
Q² =
$$\frac{70}{0.00514}$$
 = 13,600
Q = $\sqrt{13,600}$ = 117 g.p.m

PART II.—DISCHARGE FROM EXISTING AND PROPOSED MAINS. Friction Loss between A and B

The friction loss H_{AB} between A and B is given by :—

$$H_{AB} = C_1 Q^2$$

where $C_1 = \frac{H_1}{(Q_1)^2}$ (1)



Approximate Discharge from Proposed Hydrant at end of Proposed (or Existing)

Main, Deduced from Discharge at Nearest Existing Hydrant. Actual Flow Test at B—Static Pressure = H_1 ft.; Discharge = Q_1 g.p.m. Deduced conditions at C—Static pressure = $H = (H_1 \pm H_2)$ ft.* Discharge = Q g.p.m.

If C is lower than B take + sign in front of H₁. If C is higher than B take — sign in front of H₂.

 C_1 is determined by means of an experiment with a hydrant flow gauge at the existing hydrant B.

Friction Loss between B and C

Friction loss H_{sc} between B and C is given by :--

$$\mathbf{H}_{\mathrm{ac}} = \mathbf{C}_2 \mathbf{Q}^2 \quad \dots \quad \dots \quad \dots \quad (2)$$

where C_2 is a constant which is dependent upon the length (L feet), the diameter (D inches) and the " condition " of the main between B and C.

For "smooth and new" C.I. pipes

$$C_2 = 0.00115 \frac{L}{D^5} \quad \dots \quad \dots \quad \dots \quad (3)$$

For "old " C.I. pipes

In formula (3) above, the constant has been selected so as to agree as closely as possible with Barnes formula for new C.I. pipes.

In formula (4) above, the discharge of "old " C.I. pipes has been taken as two-thirds of the discharge of " new " C.I. pipes under the same conditions of head. This is in accordance with the Williams-Hazen formula.

The arithmetical value of C2 may be determined either by calculation from formula (3) or (4) or by means of the new type line chart for C.I. pipes in the following manner :---

- (1) Assume a discharge Qx: It does not matter which discharge is assumed but it is as well to assume a discharge which is approximately equal to the quantity to be expected.
- (2) Place a set-square on the line chart so that one side intersects the assumed discharge and the diameter of the main while the second side intersects the condition scale at the appropriate condition (new, ordinary, old or very old).

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Read off the friction loss in feet per 1,000 and multiply by the length of main in thousands of feet.

This gives the actual friction loss Hx in feet corresponding to the assumed quantity Qx flowing through the main.

Hence
$$C_2 = \frac{Hx}{(Qx)^2}$$

For example, if the extension consists of 4,000 ft. of 6-in. "smooth and new" C.I. main, we have from formula (3) : -

$$C_{2} = 0.00115 \times \frac{4,000}{6^{5}}$$

= 0.00115 × $\frac{4,000}{7,776}$
= 0.000591

Alternatively use new type line chart and assume flow of 100 g.p.m. (6,000 g.p.h.).

Sct line chart so that one side passes through 6 on the diameter scale and 6,000 on the quantity scale and so that the other side passes through "smooth and new" on the condition scale.

It will be seen that the second side passes through 1.45 ft. per 1,000 ft. on the loss of head scale.

Hence total loss of head in the main which is 4,000 ft. long is

4 × 1.45 = 5.8 ft.
Hence
$$C_2 = \frac{5.8}{(100)^2} = 0.00058$$

which agrees closely with the value obtained by calculation.

Total Friction Loss from A to C.

Total friction loss H_{AC} between A and C is given by :---

Under full-out conditions H_{xc} is equal to the static pressure (H ft.) at C which is equal to $(H_1 \pm H_2)$ ft. (the positive sign being used when C is lower than B and the negative sign when C is higher than B).

Hence full-out discharge Q to be expected at point C is given by :--

$$\mathbf{H} = \mathbf{H}_{\mathbf{I}} \pm \mathbf{H}_{\mathbf{2}} = (\mathbf{C}_{\mathbf{1}} + \mathbf{C}_{\mathbf{2}})\mathbf{Q}^{\mathbf{2}} \cdot \cdot \cdot \cdot \cdot \cdot \cdot (\mathbf{6})$$

$$Q = \sqrt{\frac{H}{C_1 + C_2}} = \sqrt{\frac{H_1 \pm H_2}{C_1 + C_2}} \cdots \cdots \cdots (7)$$

Open-End Discharge

To deduce the approximate open-end discharge subtract the flow constant C_{μ} for the hydrant alone from the total flow constant.

Hence $Q_{open end} =$

$$\sqrt{\frac{\mathrm{H}}{\mathrm{C}_{1} + \mathrm{C}_{2} - \mathrm{C}_{\mathrm{H}}}} = \sqrt{\frac{\mathrm{H}_{1} \pm \mathrm{H}_{2}}{\mathrm{C}_{1} + \mathrm{C}_{2} - \mathrm{C}_{\mathrm{H}}}}$$

For Cambridge hydrants the value of $C_{\mu} = 0.001$ approximately.

Example (1).—The conditions at a hydrant in the company's area are as follows :—Static pressure = 45 lb. = 104 ft.; hydrant flow = 150 g.p.m. It is proposed to lay a 4-in. C.I. main 3.400 ft. long from the hydrant to a point at approximately the same level as the first hydrant.

Deduce :---

- (A) The discharge through a hydrant at the end of the proposed main.
- (B) The open-end discharge through the end of the proposed main.

For existing main :---

$$C_1 = \frac{104}{150^2} = \frac{104}{22,500} = 0.00462.$$

For extension :---

Assume flow of roo g.p.m. (6,000 g.p.m.), then from friction chart loss of head = $ro \cdot 2$ ft. per thousand, so that for the whole main the friction loss would be $3 \cdot 4 \times 10 \cdot 5 = 35 \cdot 8$ ft. approximately.

Hence $C^2 = \frac{35 \cdot 8}{100^2} = 0.00358.$

Hence for complete main $C_{1} + C_{2} = 0.00462 + 0.00358$

$$C = C_1 + C_2 = 0.00402 + 0.00358$$

= 0.0082
$$H = 104 \text{ ft. as for first hydrant since level is same.}$$

Hence Q = $\sqrt{\frac{104}{0.0082}} = \sqrt{12,700}$
= 113 g.p.m.

The above figure gives the discharge through a hydrant at the end of the main extension of similar type to the hydrant at the end of the existing main.

For open-end discharge, subtract the constant C for the hydrant alone (0.001 approximately for Cambridge hydrants) from the total flow constant which in this case = 0.0082.

Hence
$$Q_{\text{open end}} = \sqrt{\frac{104}{0.0082 - 0.001}}$$

 $\cdot = \sqrt{\frac{104}{0.0072}}$
 $= 120 \text{ g.p.m.}$

Example (2).—The conditions at a hydrant in the company's area are as in Example (1).

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The diameter and length of the proposed extension are as in Example (I), but the end of the proposed main is :--

(A) 40 ft. above the existing hydrant.

(B) 15 ft. below the existing hydrant.

Find in each case the discharge through a hydrant at the end of the proposed main.

For the existing main :---

 $C_1 = 0.00462$ as before.

For extension :---

 $C_2 = 0.00358$ as before.

For complete main : -

 $C = C_1 + C_2 = 0.0082$ as before.

Hence in Case A

$$Q = \sqrt{\frac{64}{0.0082}} = \sqrt{7.800} = 88 \text{ g.p.m.}$$

And in Case B

$$Q = \sqrt{\frac{119}{0.0082}} = \sqrt{14,500}$$

= 120 g.p.m.

Example (3).—The conditions at a hydrant in the company's area are as in Example (I).

It is proposed to lay a 4-in. Class B asbestos cement main 3,400 ft. long, from the hydrant to a point at approximately the same level as the first hydrant.

Deduce the discharge through a hydrant at the end of the proposed main.

For existing main :---

 $C_1 = 0.00462$ as before.

For extension :—

Assume flow = 100 g.p.m. (6,000 g.p.h.), then from friction chart for asbestos cement mains loss of head = 36 ft. approximately.

Hence
$$C_2 = \frac{36}{100^2} = 0.0036$$

Hence for complete main :---

$$C = C_1 + C_2 = 0.00462 + 0.0036$$

= 0.00822.

H = 104 ft. as for first hydrant.

Hence
$$Q = \sqrt{\frac{104}{0.00822}} = \sqrt{12,700}$$

= 113 g.p.m.



DIAMETER & CLASS OF MAIN - INCHES

NEW TYPE LINE-CHART FOR LOSS OF HEAD IN UNCOATED CAST-IRON PIPES

FROM BARNES' FORMULA; V =13.39 C.D." (H/L)⁵¹² WITH ALLOWANCE FOR AGE OF PIPE ACCORDING TO WILLIAMS-HAZEN FORMULA (CONSTANT C) (C."I FOR SMOOTH & NEW PIPES, % FOR ORDINARY PIPES, M FOR OLD PIPES & M FOR VERY OLD PIPES

NOTE ON THE USE OF THE CHART

The Chart will be seen to consist of two sets of parallel scales at right-angles to each other. The graduetions on these scales have been so designed that if any straightline is drawn through one set of scales intersecting them at cortain values of the Quantities marked thereen, then any other strought line at right angles to the first straightline will intersect the second set of scales at corresponding values of the quantities marked thereon The three diagrams undernast show how the chart can be read by means of a 12 inch transparent Setsquare and a Straightedge



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THE MIND OF THE SOLDIER.

By "SENTRY."

THE first thing that any writer who wishes to sell his wares must learn is that his opening sentences must grip the attention of his reader. Mr. P. G. Wodehouse realized this when he opened one of his books with that classic sentence : "At this moment, the laurel bush, which had hitherto not spoken, said 'Psst'." By this action Mr. Wodehouse obeyed the first principle of writing, gave Mr. Beach, the butler of Blandings Castle, a nasty jolt, and—most important made an irresistible appeal to the

minds of his readers.

The present writer, in a moment of intermediate alcoholism, allowed his impenetrable disguise to be penetrated, and was rewarded by being given the opportunity to address some five hundred defenceless potential officers.* One of the audience, either from a feeling of gratitude or revenge, subsequently asked whether there was at the War Office a Department of Psychology. To gain time, the questioner was asked whether he had any psychological qualifications; the situation was not improved by the reply that he



THE MIND OF THE SOLDIER!

was not a reader and student of the subject, but was the holder of a degree. Having successfully flattened out his questioner, the writer having taken the optimistic but not necessarily correct interpretation of the question, decided to embark on a subject for which he has no qualifications beyond optimism, and a number of extremely happy years' service with soldiers.

Psychology, the study of the mind, is a tedious subject, to be classed with others suggested by the words algebra, leading articles, logic, lice, administration, the unmarried surplus, and statistics. All the suggested subjects, particularly those suggested by the words statistics and lice, have however had important reac-

* "Sentry's" Address is given on page 537.

tions on human happiness. It is therefore possible that the subject of psychology, even if treated in an amateur way, may have some military value.

There are many imponderable problems to be answered by the expert military psychologist. For instance, what is the psychological effect of the ammunition boot? Why does every soldier adopt a particular adjective for every object or idea, varying from a serjeantmajor to a shovel, from a superlative act of gallantry to a spell of Punishment Diet Number One in the glass-house? Does the continued use of this adjective affect either his ——ing or his fighting efficiency? Should an officer be a libertine and an embezzler, or should he only be considered as such? Or should he not only be, but be recognized as, a pure and upright British Gentleman as defined by



THE MILITARY PSYCHOLOGIST

David, Chaucer, Tennyson, Ivor Novello, and others? These and other problems must be left to the expert.

The simple soldier can at best note certain tendencies in the behaviour of his comrades and endeavour to draw common-sense conclusions. Why is the soldier so often in times of peace the target for sneers and contempt? Why so often in war in the face of the enemy does he give such incredible value for money? Why at all times when in uniform in a large city does he appear more completely lost than a pet dog separated from its "mother"? Yet why

does a soldier as a stranger in a strange city get more fun and games for his money than any less privileged member of the community?

So long as he can confine himself to rhetorical questions, a writer is in a strong position. As the lady said, "so far, so good." "So far, no farther," the editor will probably say unless some serious and constructive work is not quickly forthcoming. But here a difficulty arises. In considering the mind of the soldier, it is best to start with inferences from his funny little cap, or from his heavily studded boots? The soldier's reply would probably be, "Blimey, stick to the adjectival belly; let's have a bit more adjectival pay, and a bit less adjectival red tape, and verb off." But though he would be expressing some truth in this remark, he would in the main be wrong.

The human mind would appear to the amateur to be divisible into two main sections. The first section is common to us all, represented for instance by a colossal sense of humour, a profound knowledge of how badly everyone else does his job, a feeling of frustration because the system prevents us being Prime Minister, and a shame-faced admiration, and even more shame-faced fear, of the policeman and all he stands for. The second section consists in what is left over in each of us. And in our race, the Highest Common • Factor is lower than in other races, and unfortunately for the professional, as well as for the amateur psychologist, the balance is higher.

The other day a soldier was "awarded" a short dose of C.B. for being improperly dressed. He was wearing a vest of a type not issued by any Quartermaster. During the hours of meditation made possible by his spare time scrubbing, potato peeling, and reporting to the guardroom, the soldier evolved a Great Thought. He said, "I have always liked silk undies, but I don't really mind shedding them. I quite like my battledress. But in spite of the hairiness of my present vest, and of my scrubbing, peeling and reporting, my soul is still my own." The astonishing thing is that in spite of his coming from one of our great universities, this soldier was speaking an unspoken thought of much that is best, and least acknowledged, in our Army.

There are four deductions to be made from the foregoing frivolities. First, it is essential if the soldier is to play his part in his team, and stand up to the great strains of war, that his H.C.F. should be increased in certain respects. Second, in spite of this, there is a balance of private property left over in the mind of every soldier. Third, if the best is to be had out of every soldier, and therefore out of the unit, it is not only necessary to build up the H.C.F., but it is also necessary to exploit the private balances. Fourth, the soldier, like everyone else, does not wish his soul or his mind, or whatever you call it, to be messed about with. It is practically the only private property he has, and he safeguards it by denying its existence by word and action. The approach to these private balances must therefore be even more indirect than the approach to the H.C.F's.

The German propagandist recognizes the above truths. He cannot attack satisfactorily the first, but he can and does tackle the others. No effort is spared which will muddle thought and fly-blow ideals. Every effort is made to promote and exploit jealousies, to shake confidence in the assumptions which give strength to our system, and generally by producing anarchism of thought to cause a reduction of output. His direct approaches to our minds are clumsy, always recognizable, and generally futile. His indirect approaches are more subtle. If a practical example be required of the effect of muddle on the mind, let the instructed reader first listen to any one good political speaker at the Marble Arch on a Sunday afternoon. If further evidence is required, try the effect of listening to three or four such speakers, one after the other. Needless to say, this example is not quoted as one of German propaganda, but merely to enable readers to test for themselves how difficult it is to retain a clear line of thought in the face of a barrage of indiscriminate mental intake.

Military Training is in the main directed into two channels. The body must be up to the tasks it may be called upon to undertake. The brain must have the necessary degree of knowledge for the particular tasks of the individual. But a similar degree of insistence on the development of the best frame of mind in each individual is not, at any rate at first sight, apparent. The main theme governing "other rank "training is generally one of "absolute obedience " based on what might be called the " theirs not to reason why" school of thought. During the past fifty years the physical training in the Army has made tremendous progress. There is no comparison between the evenly developed physique found throughout the Army to-day, and the bulging monstrosities which emerged from the P.T. schools of yesterday. Similarly a big advance has been made in the systems used for the instillation of knowledge. But the advance made in efforts to direct the soldiers' thoughts, and in the evolution of his mind, is not so apparent. This is curious, since one of the big social revolutions during the last fifty years is the introduction of universal education. Consequently, whatever may be said to the contrary, the average intelligence of the recruit, and his power for independent thought, has risen tremendously. There is to-day in the ranks a wealth of intelligence and reasoning power, which is found by some to be almost an embarrassment.



The "theirs not to reason why" school will argue that the finest exploits of the British Army have been achieved through blind and implicit obedience of orders. This may or may not be true. It is certainly true that in any army, certain individuals and units must at times be called on to carry out orders which appear *prima facie* to be foolish, and which will probably result in disaster to the particular individuals and units concerned. It is therefore still-

a fundamental truth that obedience, and unquestioning obedience, of orders is of the most vital importance. But it is equally true that with a higher degree of intelligence spread lower down in the army, blind and unreasoned obedience is not so easy to obtain. This fact gives rise to a difficulty of no small magnitude. A lower degree of courage is required to face danger without qualms based on knowledge and prevision of the risks entailed, or without doubts as to the wisdom or the need for facing the particular danger, than is required to face danger with the full appreciation which is derived from a high capacity for reasoning.

At first sight this difficulty might be interpreted as almost insuperable. It is accepted as insuperable by those who argue that increased reasoning power and education makes the soldier soft, and inferior to the "good old beer-drinking type." But this is not the difficulty.

It is a fact that as a man's brain power and reasoning power develops, there is a corresponding and even greater development in the driving power behind the brain and the body, since this driving power—call it the mind—gains in strength through an added sense of responsibility. Cromwell recognized this when he built up his army with "Men of conscience, who knew their cause, and loved what they knew."

The difficulty lies elsewhere. If it can be analysed and overcome, the result will be a finer army than was possible when discipline was based—if ever it was so based in the British Army—on blind and unreasoning obedience.

The difficulty appears to be this. To obtain the H.C.F. necessary in the minds and bodies of the soldiery, a considerable degree of mass production training and of herding is essential. The Army, the formation, the unit must be welded into corporate bodies. The team spirit must be produced. The interests of the individual must be subordinated. A high degree of uniformity must be established. The spirit of the unit must be brought to life. But the unit is composed of a large number of thinking individuals, and if the very best results are to be obtained, it is necessary to go beyond the accepted mass production systems if full benefit is to be obtained from the potential driving force which can be built up in the minds of individuals with a high degree of reasoning power. Here therefore are two apparently rival claims; the unit demands that the H.C.F. of its component individuals shall be the highest possible ; and this H.C.F. is gained through mass production ; the individual demands special treatment, and may indeed lose value if unduly subjected to mass production training.

These claims are however not rivals. They can be made the closest of allies. But if not treated carefully they can be the bitterest of enemies.

Generally speaking, the product of the H.C.F. in the soldier is the work he does automatically, or because he must. The product of what is left in his mind is what he does because he himself wills it. When all is said and done, apart from physical capacity, what he wills depends on his conscience and on his emotions.

Now the conscience of the soldier can and should be developed during his mass production training. It will gain strength if he knows that he is a member of a "good show." There is nothing more depressing than to meet a soldier who has been transferred from a good unit to what he describes as a "heap," or more commonly an "adjectival heap." It will gain further strength if he knows that his unit has always been a good show, and has in the past
given evidence of its worth. It will be reinforced by example, particularly by the example of the officers. If that body of indolent sycophants wearing the old school tie indicate a degree of keenness and knowledge, without of course thereby giving rise to extra "red tape" for him, he will not only follow suit, but he will begin to wonder why they bother. The appeal to conscience is not direct; if it were it would fail. It is not a lightning stroke; it is a process. It is not a pulpit appeal from a pontiff; above all things it is not a matter of words.

The matter does not rest here. Conscience and a "sense of responsibility" are practically the same thing. Every man must be strengthened as much as possible by being given whenever possible the power to show that he can be left to himself, and be relied on to put up a good show. There are few things more depressing to a member of the human race than never to be given a job unaccompanied by a taskmaster.

Before abandoning the conscience, it is necessary to make one point clear. In its usually accepted sense the word denotes a still small voice which is continually saying "Don't." The Oxford Concise Dictionary defines it as " Moral sense of right and wrong." That definition goes somewhat beyond the meaning conveyed above, and it would have been more correct to have qualified the word throughout by the word "Military," which being interpreted. again by the O.C.D., is "Befitting soldiers." This of course lets the soldier out of a packet of trouble, since by custom and right, he is entitled to a modicum of brutality and licentiousness. fostering the soldier's conscience, therefore, the officer should be careful not to go too far. What the soldier does out of barracks in his own time must be governed by his own non-military conscience. provided the latitude of conduct thereby achieved does not bring him into conflict with military regulations, or render him unfit for military service.

So far it has been established that what a man does depends on what he is made to do, and on what his own will forces him to do. What his will forces him to do depends on his conscience and on his emotions. Turning to the Dictionary, this time before plunging into a sea of words, we find that emotion is defined as feeling; turning to feeling, we find it defined as emotion. Further investigation will bring to light that about the nearest definition is that emotion is a state of mind not entirely based on reason. This definition is at any rate good enough to go on with.

Before proceeding, there is one hole to be stopped. It may be argued that discipline is designed largely to enable the soldier to overcome his emotions, and do that which is right, even under the most trying circumstances. It is true that discipline may tip the scale against the emotion of fear. It may put the brake on other deplorable emotions, which we could all well do without. But if the matter be considered, it is clear that most disciplinary training consciously or unconsciously makes the strongest possible appeal to the more laudable emotions.

Although it is true to state that the appeal to the conscience must invariably be indirect if it is to be successful, this cannot be said



THE EMOTION OF FEAR

with equal truth about the appeal to the emotions. Everyone knows that a powerful appeal at a critical time by a strong personality has frequently saved an otherwise hopeless position. But such direct appeals depend largely on the Occasion and the Man. Such appeals are not further discussed, beyond pointing out that to be of maximum strength they must appeal to as many emotions as possible. It may well be that if the ground has not been prepared before, even the strongest personality may be unable to stir more than one or two emotions. If he has in some way previously been able to stimulate in his men such emotions as loyalty and gratitude, he will clearly have a better chance of making a successful appeal in a time of stress.

This leads to the conclusion that, as with the appeal to the conscience, so with the appeal to the emotions, an indirect and long term of approach is possible. At first sight such an approach may seem rather a tall order; but if the subject be analysed, it is found to be one of extreme simplicity. The main reason for this is that the British Soldier is extremely generous in his judgment of his officers. In some ways the position is analagous to the attitude adopted by the newly engaged young man to his sweetheart. The officer has lived in a different world. He belongs by his rank to a different military class of humanity. His military duties do not require him to carry the same loads as the soldier, to undergo the same long periods of hard physical work, or to live under the same degree of discomfort. He may therefore be a gentler, and a more fragile creature than the soldier without incurring contempt, and he may be allowed to have certain whims and fancies without incurring undue irritation. So far the officer shares certain advantages with the young lady. But he lacks one-shall we say-quality, and he must make up for this deficiency by possessing certain other qualities.

Unlike the young lady, the officer must be absolutely fair in the way he exploits his position. He must have at least a certain minimum number and degree of masculine virtues, such as endurance, and "guts." The more the better of course. If he can show to the soldiers, without ostentation, and without in any way competing,

that in spite of his milksop upbringing he has at least an average content of the more robust masculine qualities, he will be in a position to make a successful long term appeal to the emotions of his men.

There is ample evidence available on the value of this appeal. Early in the war the men in a certain battalion were quite eloquent about the way their show was run. They noticed that their commanding officer found time to smell out and rectify, so far as he could, all their discomforts and little troubles. They described their training as interesting. They were distinctly pleased that their hours of training were shorter than those of other similarly placed battalions. Fatigues were run efficiently and fairly. There were practically no minor punishments. Finally, they claimed with complete conviction, that in spite of the comparative " cushiness " of their unit, it was the best in its group at all its work. Later in the war, that battalion was called upon to carry out two tasks, either of which might easily have resulted in its annihilation. and both which must have appeared to the ordinary soldier as pretty desperate. The men in discussing the second and more dangerous task commented on their C.O. They explained that. they were in close contact with superior forces, and that the position out in front was exceedingly unpleasant; but that the one man who knew the whole position, and was seen everywhere was the Commanding Officer. In spite of lack of battalion transport he got round by commandeering a rickety old French car. The general comment on the C.O. was that he had brains and guts. But as the beer consumption went on, enough was said to indicate the lengths to which those men would go simply on behalf of their C.O.

Another example is provided by a very young Second-Lieutenant. He took over his platoon in the line in Belgium under most unpleasant circumstances. His predecessor had failed lamentably. The platoon was in a most unhappy state. He got things right very quickly. Finally, he and the remnants of his platoon became detached from the rest of the unit. He piloted the party back some hundred miles through country which was rapidly filling up with enemy, and in doing so collected round him about 150 odds and ends. Under the circumstances, this effort was by no means a small one, and involved on several occasions calling for the sacrifice of parts of his command. From the way some of the soldiers spoke, it is quite clear that this would have been impossible unless the officer had in some way gripped the imaginations of his own men, and succeeded in making some appeal which was guickly passed on to the rest of the party. His final words, on arrival at Dunkirk, by then in an advanced stage of decrepitude, certainly pleased them. He said something like this-" Now I've got you back home safe and sound you can bloody well look after yourselves."

The sort of response indicated above comes fundamentally from the appeal made by the mind of the leader to the mind of the led. But one mind cannot make a direct appeal to another. The only evidence available to another man as to the workings of a man's mind comes from his words and deeds. If an officer is known by his men to refer to them as " the common herd," and if his actions supply further evidence of this frame of mind, there is unlikely to be a favourable reaction in the minds of the men. If an officer exhibits by his actions—not by his words—a more favourable frame of mind, the reactions will be quite different. One of the casiest differences in an officer's mind for the men to spot, is whether he is thinking primarily of them or of himself.

One thing is reasonably certain, and that is that a sound frame of mind in an officer will induce, or tend to induce, an equally sound frame of mind in his men. What particular emotions should the officer try to stimulate in his men, and in what particular ways should he therefore try to direct and control his own will and mind?

The list of laudable emotions is a very long one. For instance, one could start with faith, hope, and charity, but it is doubtful if an officer's time in the army can best be spent in stimulating these emotions. The Serjeant-Major, for one, might be found in opposition even to the most indirect approach, though he might well be wrong in one case. The Serjeant-Major would be even more offended if love and piety were selected, and he would undoubtedly throw in his hand, if meckness and humility were chosen.

But provided the approach was indirect, and the C.S.M. did not really quite understand what the officer was getting at, he could probably enlist at any rate a lukewarm co-operation if he started on loyalty, confidence, gratitude, and self-respect. It may be noted that of these, confidence and self-respect hardly come normally under the heading of an emotion. But in times of stress, what may normally be described as a state of mind tends to become an emotion, in that it becomes " a state of mind not entirely based on reason."

Taking loyalty, the state of mind of the officer should be such that his actions indicate loyalty to superiors, to equals, and above all, to subordinates. His visible contribution towards mutual confidence must obviously be knowledge of his job, and faith (in spite of the Serjeant-Major) in his subordinates. Gratitude can be inspired by a state of mind which always places the interests of the men before that of the individual officer in command of them. Self-respect in the men can be induced by their knowledge that they belong to a good show, and in addition are, each individually within their means, efficient soldiers.

The list given above of favourable emotions to which an appeal can be made indirectly and with good results is admittedly not complete. The great leader, the man of genius, could tackle success-

[DECEMBER

fully a great many more. Oliver Cromwell, for instance, set himself a much greater task. In this connection it is of interest to remember that the lasting blot on Cromwell's name came from certain action taken by his troops which could not be reconciled with the specifications he laid down for a good soldier.

But enough has been written to indicate one truth. The whole psychological argument, which since it comes from a complete amateur may be false of course, leads to the conclusion that the general organization and training of the army is absolutely sound, from a psychological military point of view. The framework provides for building up in the soldier's mind that Highest Common Factor without which he cannot be expected to stand the strains of war. In addition it gives ample latitude for developing the particular strengths of the individual. Ways and means have been suggested in previous articles. The great thought which comes from these pages of profound psychological argument is the rather old, but sometimes forgotten one, that it is the minds and wills of the soldiers which win wars and battles, and that these minds and wills are directed by the minds and wills of those individuals, from top to bottom, who make up the Corps of Officers.

A BRUSSELS BRIDGE SOMERSAULTS.

By MAJOR G. D. CLOTHIER, A.M.I.E.E., R.E. (T).

THE blowing of the many bridges over the Canal de Willebracck (which cuts through the centre of Brussels) in the early hours of 18th May, 1940, shortly after the Germans breached the French line on our right flank, was probably the biggest demolition operation in history to that date. Of these demolitions, the road bridge on the Rue de Bonne, which turned a partial somersault, was perhaps the most spectacular.

It was an arch-shaped, three-span, reinforced-concrete bridge, 48 ft. wide and 142 ft. long, standing some 25–30 ft. above canal level. Instead of piers, the bridge stood on two rocker bearings astride the canal, with cantilevered side bays resting on roller bearings on the abutments.

Being afraid that the then almost untried "overload" charge might do little more than remove the concrete for a short gap of 5-ro ft., leaving the bridge standing, we decided that the bridge could be cut and tilted with an "overload" charge of 2,000 lb. of ammonal calculated strictly from the $4H^{2}T$ formula, placed across the centre span about two-thirds distance from one pier, combined with a lifting charge of 800 lb. of ammonal placed between the rollers under the bridge on the corresponding abutment. The object was to shatter the centre span and obtain a turning moment about the pier by the overhanging weight of the centre span, assisted by the lifting effect of the abutment charge.

Some 8–10 hours only were available for preparation, and the work was started whilst reconnaissance was still in progress. Using the compressor, the road surface was trenched, and the overload charge was placed directly on the concrete across the full width of the bridge, well tamped on top by sandbags. The preparation eventually took 12 men 12 hours, as it was their first demolition and undertaken at night.

As will be seen from the attached sketch, the bridge turned a partial somersault actually remaining on the pivot, half of the bridge remaining in position. The overload charge did not cut the reinforcement, but the effect of the turning moment was to wrench it out of the concrete, leaving it hanging raggedly in position. The lifting charge on the abutment blew the face of the abutment away and shattered the end of the concrete cantilever. This example, amongst many others, shows that the reinforcement is not cut by an overload charge, and that when possible, demolitions should be so planned that the dead weight alone will be sufficient to destroy the reinforcement. The effect of the overload charge should be augmented by a suitably placed lifting charge. The combined turning moment of these two charges is very great.



EDITORIAL NOTE.

The method adopted and described above closely follows German teaching, and is useful for cantilevered structures. For normal horizontal spans, end supported, the overload charge should, however, be placed at the centre of the span.

Provided the construction and filling of the abutment had permitted the use of the camouflet equipment, four 80-lb. craters would have been as quick and much more economical and effective.

1940.]

SIR JOHN BURGOYNE ON THE DEFENCE OF THE BOSPHORUS AND THE DARDANELLES.

To LORD RAGLAN, 14th April, 1854.

"Ordnance Office, London, 10th April, 1854.

" My Lord,

"From the remarks with which I am met on every side, relative to the conduct of the war in Turkey, I think I can perceive that the tendency of some of my recommendations has been misunderstood.

"It seems to be assumed that, in urging forcibly the preparation of the position in front of Constantinople to cover the Bosphorus, I am inclined to consider a purely defensive attitude as one of absolute necessity, and that all the efforts of the Allies are to be restricted to remaining there and at Gallipoli, in whatever force we may be, with 'our arms folded,' and until the enemy shall choose to attack us. Such was never my idea, nor do I think that my expressions will justify such a conclusion. On the contrary, I see reason to hope that openings may be presented to enable us to undertake proceedings more energetic and more effective against the power of Russia; but my wish is for the establishment of a firm base of operations, calculated to meet any emergency, and to give us an independent freedom of action to a more extended range.

"The first impressions on the commencement of the war between Turkey and Russia were, that the latter would cross the Danube this spring with a formidable army, and in such power as could not be resisted by any forces the Turks could oppose to them, and it is to be expected that such may still be the case. The result of that attack might be of an overpowering nature, particularly if the Turks were subjected to such complete defeat in Bulgaria as absolutely to incur the risk of allowing the enemy to penetrate to Constantinople towards the end of perhaps the first campaign. At the same time, it was not at all clear what land forces the French and British Governments might be inclined to contribute to the support of their Ally.

"Under those circumstances, the occupation of a stronglyentrenched position in front of Constantinople might have prevented the final catastrophe, and perhaps, if the attempt was made, have caused a great reaction in favour of the Turks. Nor do I perceive, in the course of subsequent events, any reasons for deviating from the policy of that measure.

"Whether the Russians shall be able to produce such an extreme effect or not, we must anticipate that they will have an ascendency of force on the Danube, and will succeed in penetrating into Bulgaria, and at least threaten an advance on Constantinople. In that case also, the stronghold covering the Bosphorus and the capital, by the barrier it will present, will afford a feeling of confidence and security that will give greater facility for operating elsewhere ; and it seems to me to be particularly desirable to have such a hold as the startingpoint or last retiring ground for the French and British forces ; but, above all, as a security for our fleets in the Black Sea, which otherwise must quit it, and abandon the immense advantages that our ascendency over its navigation gives to the common cause, and which, without such a hold, must have a precarious tenure. While I perceive all these advantages in the early and energetic preparation of that important position, in no way can I find any disadvantages to it. It does not necessarily absorb any strength of force for its occupation, because troops can be thrown into it, in ample time, at any period of danger.

"The reason I have always been so pressing for this precaution, which seems to have given an undue impression that I thought it all in all, is, that I have perceived, and still perceive, a difference of opinion on the subject, and a reluctance, particularly among the French, to resort to it.

"Even as a preparation for the most determined offensive enterprises in the Black Sea, I consider such occupation as of primary importance.

"There is no difference of opinion about the propriety of giving a great degree of strength to the European Peninsula of the Dardanelles; and if a similar preparation be admitted for the one in question in front of Constantinople, and both be actively accomplished, we have two strongholds, having the effect of fortresses, in most important positions, absolutely covering the two essential communications into the country, and affording retiring fields of action, should circumstances give the enemy any great temporary advantage. They would neither of them require any large amount of force for their occupation while the enemy should be at a distance, but, being in readiness, could both of them be amply provided with their necessary garrisons, at the last moment, from the troops previously engaged in their front, or from other sources. The armies of the three Allied Powers would therefore, in the meantime, be fully available for any other operations. What those operations might be that could be undertaken with any prospect of success, must depend upon the course of succeeding events, the value of the objects to be gained, and the openings afforded by the enemy. Some will be much more desired by us than others, like the capture of the Crimca and Sebastopol, but they are likely, on that very account, to be more jealously guarded against by the enemy.

"By our naval superiority in the Black Sca, the whole of its coast will be open to our enterprises.

" If the principal offensive advance by the Russians across the Danube be into the Dobrutze, as seems to be at present understood. it is not a bold measure, nor one likely to be attended with the powerful effects of a passage at a more central point. It indicates a very cautious policy, to which the Turks will be able to give a direct opposition, by a concentration of the whole of their forces from Rustchuk, to their right on the Black Sea, with a clear retreat open to them to Shoumla, Varna, and the Balkan ; while the large force which it is understood they have at Kalafat, might, perhaps, make a powerful diversion into the heart of Wallachia, maintaining for greater security, the command of a perfect communication with the Danube on their right, on which, as it advanced, would be its connection with Bulgaria, and a new line of retreat in case of necessity. Omer Pacha, who is in immediate command on the right, has professed great confidence in his power to contend with the Russian army in the field, and if he can have collected his forces on the position of Trajan's Wall, which closes the gorge of the Dobrutze, and the enemy not have passed the Danube in force elsewhere, there may be great hopes that, if not absolutely gaining a battle, he may have subjected his opponents to such loss, and have shown such a formidable front, as greatly to damp their energies, and give them but little hopes of making much impression on a country where their native enemies are likely to be supported by any amount of French and British troops.

"Such an amount of resistance, even attended by a retreat in some order, although the enemy might obtain what he would term a victory, and a partial advance into the country, might be considered a triumph, as it would be a sure indication of a power of a prolonged defence on the main line of attack, while the whole coast of the Black Sea, and the southern extremity of the Russian possessions, would be exposed to the efforts of the Allies.

* * *

"The object, however, of this communication, has chiefly reference to the occupation of a position between the Sea of Marmora and the Black Sea, being not only quite compatible with any extent of active enterprise against the enemy, but absolutely tending to facilitate it.

"The position of the Allies in Turkey will be in some respects analogous to that of the British in Spain and Portugal; the enemy's organised army then being in overpowering force to that of the British, while the movements of the native troops could not be closely combined with them, enabled great efforts to be made upon

them, which, without a rallying-point, could hardly be resisted. Thus the unhappy retreat of Sir John Moore, and what would, to any other man, have been the dangerous position of the Duke of Wellington at, and after, Talavera. Circumstances were much improved by the subsequent establishment of the Lines of Lisbon, to which the Duke retired in 1811, under the pressure of the advance of the French army, and in spite of the taunts and abuse of the Press in England, headed by the veteran Cobbett, and though those Lines were maintained throughout the War, they were not afterwards resorted to, nor did they prevent the most active enterprises at a distance from them. The Duke, however, had two advantages in the Peninsula which will be far from attending the British and French generals in Turkey. One, the universal strong feeling of the entire population against the enemy, while in Turkey one half of the people will be, to say the least of it, indifferent ; and the second, the excellent information he constantly possessed of the state and proceedings of the enemy, which hitherto seems to be totally unattainable from within the lines of the Russians.

" I have, etc.,

" J. F. Burgoyne."

THE TCHATALJA LINES.

(30th March, 1854.)

"Colonel Ardant has examined the position of the Karasou, between the Sea of Marmora and the Black Sea, covering Constantinople and the Bosphorus, and fully confirms the reports that had previously been made in its favour by Lieut.-Colonel Jourjon; the really accessible part of this position across the ridge between the valley of the Karasou and the Lake Derkous is about 9 miles in extent, of commanding undulating heights, overlooking without interruption a great line of plain country, and well indented for defensive works; thoroughly entrenched, and with a force of 50,000 good troops, it could hardly be forced." By BRIG.-GENERAL SIR JAMES E. EDMONDS, C.B., C.M.G., D.LITT,

THE "SHOP" SIXTY YEARS AGO.

I was a cadet at the Royal Military Academy from September, 1879, to July, 1881; an Instructor in Fortification there from the beginning of 1890 to the end of 1895; G.S.O.I of the 4th Division (which then had its headquarters in Woolwich), 1911–14; and I paid visits to the Academy after 1918, when two of my old cadet-pupils, Sir Ronald Charles and Hugo De Pree, were the Commandants. At the invitation of Major-General Philip Neave, I was going to celebrate the sixtieth anniversary of my joining by a visit on the 18th September, 1939; but the intervention of certain Powers of Evil prevented this.

In the sixty years many changes have taken place; for the R.M.A. has always kept abreast of the times; but one factor has remained constant: the good physique and smartness of the cadets. The excellence of the instructional staff has greatly varied.

The "Shop" in 1879 was a rough place: the accommodation and the food were rough, the cadets were a rough lot, brutal to the weaker vessels. "Ragging" was frequent, conduct in study was boisterous, and behaviour to the civilian instructors deplorable—the little crippled instructor in freehand drawing "Billy Clifton," translated "G.C." as "almost an officer and not quite a gentleman." The general discipline was poor, and "The Sword" was withheld from the S.U.O. immediately preceding me on this account. Drunkenness was not unknown: a small club, called "The Meet," smuggled liquor into the precincts, and one under-officer and two cadets were rusticated for being found drunk.

When I returned to the Academy as an instructor in 1890 I thought a great improvement in class discipline and general behaviour had taken place, and, to make sure, asked Professor Hart (he had a red beard and was known as "Sunbeam"), who had instructed me in mathematics and was still on the staff, whether I was mistaken. "No," he said, "the cadets have become quite different. You will remember that in your time there were always three instructors in the room—for mutual protection. Now it is quite safe for an instructor to be alone with his class." "Once," he continued, "I thought the class was killing a cadet ; they had placed a desk on him and as many as could crowded on to it. I got up and came to the front of my octagon [formed by the tower at the corner of the building] and cried, 'Gentlemen': but someone called out, 'Sit down, Sunbeam'—and I sat down." He attributed the change to better discipline at schools and the general desire to work and so "get Sappers."

In 1879 cadets joined in morning coats and tall hats, and paraded in them until fitted with uniforms.

The cadet company was organized in five classes, one of which normally arrived every six months, the course being 21 years ; but in 1880, owing to the Afghan War, three terms were crowded into the vear. No one was allowed to remain more than three years should he lose his class by illness or by failing in a term examination ; so normally a cadet could only drop once. The five classes were divided into three divisions, "A," "B" and "C," each superintended by an artillery subaltern-the instructional staff had no duty except to instruct in their special subjects. "A" consisted of the First Class, with the Senior Under-Officer and two Under-Officers, the rest all wearing corporal's rings unless deprived of them for some misdemeanour and these rings had to be regained before the delinquent could be recommended for a commission. The other four classes were divided equally between "B" and "C" Divisions. each under an under-officer of the Second Class, assisted by corporals of the Second Class, half of which was given that rank. The artillery subalterns and S.U.O. merely put in ceremonial appearances. Thus the whole outdoor and house discipline of the institution was maintained by members of the Second Class, the S.U.O., U.O's. and corporals having the power of giving "extra drills." Justice was administered by a Captain of the Cadet Company (a Colonel) and an Adjutant; an Assistant Governor and Secretary (a Colonel) did the administrative work. The Governor-two Generals, old Crimean veterans, officiated in succession in my time-seemed to have no duties except to deliver sentences of rustication and expulsion, and harangue the cadets after some gross breach of discipline, e.g., after the Chaplain had been pelted in Hall with lumps of sugar, or when, one night, an effective feu-de-joie had been obtained after "lights out " by all the inhabitants of " A " House shouting " fire " simultaneously, followed in succession by "B" and the other houses, so that the cry ran round the three sides of the academy buildings. The Governor was some years after replaced by a Commandant, of lower rank and greater activity.

It is not without interest to recall that in 1901 a Commission was appointed to investigate the condition of Woolwich and Sandhurst. The state of the latter was reported as unsatisfactory, the Governor, Second-in-Command and some of the staff were "sacked." Woolwich was said to be highly efficient; so it was reorganized on Sandhurst lines with the company system, the company officers to teach all subjects; but this idea had soon to be abandoned.

Cadets on joining were housed in pairs in the rooms of the old houses facing the parade ground, with a Second-Termer (from the lower half of the Fourth Class) in charge of them. All the windows had heavy iron lattice grilles, to prevent cadets from breaking out : it was hardly possible to put more than a hand out. The iron bedsteads had a joint near the head, and one of the methods of "ragging" was to fold the bed up with the owner in it, and then place his regulation trunk and perhaps a bucket of water on top, so that they fell on him when he kicked his bed down. The covered ways to the bath-sheds did not then exist, nor was hot water supplied ; the bather ran naked, sponge in hand, across the courtyard to a cold water tub, winter and summer ; but back to a glorious fire, previously kindled by his servant-and colds and influenza were unknown. No one was allowed to shirk the bath. One cadet of my term, who unfortunately for himself had a muddy complexion, was suspected of insufficient washing; he was stripped in mid-winter and cleaned down with mops; but he seemed to bleed easily, and then someone discovered that the mops were nearly frozen hard.

"Jew hunts" (to prevent "Jewish" cadets surreptitiously working in hiding places) died out just before I joined. A notice used to be put up in the Library, "Jew Hunt meet under the clock at 3 p.m.," and the buildings were searched until the offender was found, when his books and note-books were confiscated. It was contrary to cadet tradition to work "out of Academy," except in the fortnight before the examination, when much reading was done by candlelight under the table after "lights out."

The normal dress was an artillery blue tunic with red collar and brass buttons, red-striped trousers and Wellington boots, and an absurd little round forage-cap with gold band, which gave little protection against the sun and prepared the scalp for early baldness. This dress became full-dress by the substitution of a helmet for the cap, and the addition of a white pipe-clayed belt and white pipeclayed gloves-and woe betide a cadet who had a white mark on his clothes. A feature of daily life was the care with which cadets brushed each other before going on parade. An excellent great-coat, artillery officers' pattern, was provided. For riding, "booted overalls" of the pattern seen in Crimean war photographs, were worn. The lower extremities of the rather narrow trousers were strapped with black leather and fastened under the Wellington boots, which had boxes for spurs. For gymnastics (real gymnastics, not P.T., but equally effective) flannels, with a black pea jacket and a canvas belt, six inches wide, were issued. If for any reason a tunic was not available, a cadet might wear his pea jacket with collar and black tie (a made-up sailor-knot tie fastened by tongue and clip was supplied).

The canteen had not been established, but certain extras could be

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obtained at meal-times on previous written order, the cost being charged against the cadet's account. The food was ample : breakfast, with one hot dish ; " coffee lunch " (bread, butter and cheese, with jam and potted meats as " extras," and beer) in the quarter of an hour interval at 11.15 a.m.; dinner at 2.15 p.m. (meat, generally roast beef, with vegetables and pudding and beer); tea (bread, butter and jam) from 4.30 to 5.30 p.m. in Hall, but not a parade ; and a high tea, called "tea-squad," at 8.15 p.m. This last was not partaken of in Hall like the other meals (the "A" Division had a newly-built separate dining-room), but in the room of one cadet of each of the parties of four (hence the name " squad ") into which a class was broken up for the purpose. Parties sent in their names at the beginning of the term, and any residue was arbitrarily organized into four's by the under-officer concerned. This proceeding led to incongruous elements being thrown together, and in one case three brutes used to put the food for the fourth, for whom they had no liking, on the doormat outside the room. Tea, bread and butter were issued for this meal and funds allowed for the purchase of "extras"; but most tea-squads supplemented this fare with presents from home, and purchases made by the room servant, who did such cooking as was required. A serieant of the Corps of Commissionaires attended at the Library in the afternoon, available to make purchases in the town for any cadets who for one reason or other had not the time or freedom to go out. Smoking was encouraged and a ration of tobacco issued.

One member of the Board of Visitors in 1879, a General Fitzmayer, reported that the cadets were coddled, that he found some of them allowed claret instead of beer, and that in his day if a cadet's stomach was out of order, he was given an emetic. Whereupon *The World* (a rival of *Truth*) weighed in with the lines :

"The life of young Woolwich was Spartan and hard, And now it is brighter and gayer; But we back the Bordcaux which nourished a Chard, 'Gainst the emetic which brought up Fitzmayer."

It was the year of the famous defence of Rorke's Drift, on the Natal frontier, by Lieut. J. R. M. Chard, v.c., R.E.

The only illuminant in the halls of study and in quarters was gas, with the old fish-tailed burner. Incandescent mantles did not come in until about 1892-3.

A feature in the opening of a cadet's career was the "Snookers' Concert,"* which took place in two parts, in "B" and "C" Division, soon after the beginning of the term. Each last-joined, arrayed in

^{*} I was first introduced to the game of Snooker in the spring of 1889 at the R.A. Mess, Sheerness, by Major Sorell, R.A., who is said to have invented it at Rangoon a few years earlier. From its name it evidently originated with someone acquainted with the R.M.A.

fancy dress, had to parade with his sponge, which he handed to a party of Second-Termers, who sat in the front row with buckets of water handy, and to sing a song. A bad performer was pelted with wet sponges. The concerts were stopped in 1881, after a free fight at one of them, when a cadet while being flung downstairs collided and knocked over the Adjutant, who, living next door, had come in to enquire into the cause of the uproar.

The course of study was strictly preparatory for a scientific officer's career. The mathematics were of a high standard. Fortification inclined more to permanent than field, very careful drawing being insisted on, with no pencil and chalk work. The first term at Military Topography was spent in learning how to lay on flat washes and print alphabets, and at Fortification in struggling with geometry, the intersection of planes and solids, and the calculation of *remblai* and *deblai*. In the second term we practised pen-hachuring and brush shading, and drawing in full detail a bastioned front (called "Modern French"—but it was distinctly neither modern nor particularly French) and a German polygon front, with wide, wet ditches.

The military history lectures, on 1870-1 and British minor campaigns, were excellent, given by Lieut.-Colonel Sisson Pratt, R.A., for whom I have always retained a grateful memory. As a lecturer, only Colonel Lonsdale Hale and Field-Marshal Sir William Robertson have, in my opinion, equalled him. He bade us listen and not to take notes, providing a printed summary of his remarks. Strategy and tactics were not in the syllabus, nor was military law or any general history. In those days " The Slade " was not built over, and all the country between the Shooters Hill and Eltham was open fields.* so that there was plenty of ground close at hand for learning military sketching; it was mostly done with a prismatic compass and Abney's level, the plane-table not being used until the last term. Professor Bloxom taught Chemistry and Electricity, but could not keep order. High iron railings were erected in his lecture theatre between him and his class, and an under-officer sat inside the railings facing the class to spot delinquents. It was, amongst other things, customary, when the Professor first mentioned the ohm for the whole class to sing "'Ome Sweet 'Ome "-he always paused for this interlude-and when, on promise of good behaviour from the class, he turned down the gas to exhibit "Geissler tubes," the class either disappeared under the seats or clambered up the columns of the theatre en masse.

Musketry was not taught or practised. The cadets were armed with the old Snider carbine; this conveniently had leather on the breech-closer, so that in cold weather the bore could be filled with

* The R.A. Drag held its annual races on this ground, Cemetery Hill forming an excellent grandstand.

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hot water and corked, a blessing to cadets who had to perform "extra drills" in the early morning. The "A" Division went to Shoeburyness for a fortnight for artillery practice and fired the few guns then in the service, all muzzle loaders except the Armstrong 40-pdr., a Crimean polygrooved weapon, which fired a lead-coated shell with phenomenal accuracy.

An important feature of the course was the encouragement of languages. Five could be taken up, at 2,000 marks apiece. For the benefit of the unfortunates who had suffered from a Classical education, Latin and Greek were allowed to count as languages. The Chaplain lectured on them. I remember reading Terence's *Heautontimerumenos* and Aristophanes's *The Clouds* with him. Instruction was provided in French and German. The Professor of German, Dr. Schaibler, wrote an excellent book on *Deutsche Hiebund Stosswörter*, warning Englishmen and Germans of the traps in each other's languages. For languages other than those abovementioned, cadets had to make their own arrangements, and itinerant teachers (I remember Signor Conti, an Italian, and Señor Vivar, a Spaniard) either came to the cadet's room by appointment, or waited outside the railings to be brought in.

The examiners used to attend in person and sit in the room during the examinations. If a cadet objected to a question as being outside the course or wanted any explanation he could stand up and have his say. If backed up by his fellows, the examiner sometimes cancelled a question and substituted an easier one. I remember meeting one of the examiners in Mathematics, Canon Heaviside, after I was commissioned, so I thanked him for the high marks he had always given me. He replied that he had always done what he could to mark well, but was about to resign, adding, "What the dear boys will do without me, Heaven alone knows." As the attendant examiner generally did a bit of reading, or became somnolent, cribbing was easy. But there was a cadet-made rule that the cribbing must be in moderation, sufficient to pass but not to gain places, still less to "get Sappers," in times when only five R.E. commissions were given in a batch of forty. In two instances cadets known and seen to crib came out on the Sapper list ; in one case the cadet in question went to the Governor and had his name taken off the R.E. list at once. In the other, the cadet allowed himself to be gazetted : but his batch brought such pressure to bear on him, on account of the brother cadet next on the seniority list being affected, that he was forced to go to the War Office and arrange for transfer. The curious can look up old gazettes and will find that the late Colonel B. R. Ward was gazetted first to the Royal Artillery and a short time after transferred to the Royal Engineers.

Another feature of the 'eighties was the week-end exodus. Cadets were encouraged to go on leave, and quite seventy-five per cent did so. As my people lived in London, I spent exactly four Sundays in Woolwich in 1879-81 : my first two, and two as S.U.O., in order to take my sword to church. Study went on until 2 p.m. on Saturday, but by horse-cab—there was no tramway—one managed to catch the 2.40 p.m. at the Arsenal station. The return journey on Sunday night was on foot from the Dockyard station, and I and others thus early learnt the elements of night and fog marching. Woolwich in those days was, as it was said, "separated from London by the South-Eastern Railway"; every train went into Cannon Street, and the journey to Charing Cross nominally took one hour, and was never less.

The only games played were Rugby and cricket ; one tennis court was marked out on the far from level "Inner Court," but I cannot remember seeing anyone playing on it. As a matter of fact, a cadet got so much exercise at drill, "gym," riding, artillery exercises and sketching that he did not hanker after more. The football ground at the back of the Academy had not been acquired.

The Athletic Sports were, of course, held. No swimming baths had been built, and in the summer cadets were allowed to use the garrison open-air pool at Shrapnel (then hut) Barracks. The workshops and billiard rooms were much patronized but did not open on Sundays. Part of the R.A. Band played for dancing in the gymnasium three evenings a week.

There was a certain Shop slang, not as elaborate as that of the *Ecole Polytechnique*, e.g., "spange" for "best or splendid," "dunnegan" denigratory (e.g., "spange and dunnegan tunics"), which seems to have died out.

The end of all things was "Duke's Day," the passing-out day. H.R.H. the Duke of Cambridge, the Commander-in-Chief, never missed coming with most of the Headquarters Staff. The Governor's report, H.R.H's. speech, always appropriate to the particular occasion, the order of passing out, and the marks accumulated by the individual cadets (later carefully concealed from public gaze) were reported in the newspapers, and the Senior Cadet usually got a paragraph in the "Society" weeklies.

During my service I have had opportunities to visit universities, educational establishments and military schools in many lands : in France and Germany, Spain and Austria, across Russia to Peking and Tokio, and in America and Canada, West Point, Willett's Point, and Kingston ; also from Oxford and Heidelberg to McGill, Harvard and Tuscagee. For turning out the best educated, most conscientious and efficient men, ready to enter the larger sphere of life, I must put West Point, McGill and Kingston in the first rank, with the Royal Military Academy (with a shorter course than West Point or Kingston) not so far behind. I have not seen Duntroon.

CHITRAL.

More Memories.

By A. E. D.

ALTHOUGH, especially at this time, everyone in the Motherland is intensely proud of the Empire and is thrilled by the deeds done in the remotest outposts, these outposts unfortunately need to be kept "in the news" otherwise they are apt to be forgotten. The wonderful gifts now being sent home from all corners of the globe to help the war effort bring back to memory or even bring to notice for the first time many a small outpost which has lain in obscurity for many a year.

Chitral is one of those places, beyond the range of tourists, that has had but little publicity since the expedition of 45 years ago referred to in "Teve's" article in the June R.E. Journal.

The two following incidents show how little we as a nation think of these outposts of which we are at heart so proud.

Five years ago when on a voyage to Marseilles on the P. and O. s.s. *Chitral*, I enquired of the ship's officers if there was no picture on board to connect the ship with the country whose name she bore. After a bit of enquiry one officer did remember that there used to hang in the saloon a picture of the old fort and bridge, but it had been put away because in that age of pacifism it was considered to be too warlike and military to suit the tastes of passengers.

Shortly after the expedition, when my father was Colonel in charge of Chitral, after completing his command of the 3rd Punjab Cavalry, he translated to paper for the first time, with the help of a Chitrali who knew Urdu and Persian, the Kafir or Bashgali language. For this publication he received an award, not from our Empire, but from the French, whose *Académie française* gave him a medal and—something more substantial. It is curious that such an award should come from a source which had no political or trade interest in the country.

On reading "Teve's" article I looked up the letter my father wrote me on his first entry to Chitral when encamped at practically the same spot as "Teve."

" Camp. South of the Lawarai Pass. 13th May 1896.

"We made a lovely march to-day starting from Dir, which is 5,000 feet high, our march taking us 13 miles up a mountain glen, through which runs an icy cold stream. Our camp is 8,500 feet above sea level. Snow is lying very deep in many ravines all round us and some in the camp.

"The pass through which we have to go to-morrow is a depression, height, 10,500 feet above sea, in a range of mountains which runs to 14,000 feet and in places much higher. The road we go by has been cut for us through 12 and 20 feet of snow. One of the marvellous things is that, though the route is only open for traffic six months in the year, postal runners are hardly ever stopped." (In a letter written from Chitral after the following



Bridge near Borgund, Laerdal River, Norway.

Christmas, my father confirmed the regularity of the mails, even including the parcel post, and this despite an exceptionally bad winter on the Lawarai.) "Last year, one night twenty men connected with the postal runners were caught in a snowstorm and blown away. Fifteen of their bodies have never been seen.

" r4th May. This morning we started at 5.30 a.m. and passed the Lawarai. The whole range is under deep snow. In many places our route was over long snow bridges. It is a very odd experience to go over one of these and to see above you a huge avalanche which might come down as you are crossing, and of course make an end of you. In the day one can hear many of these avalanches falling. The scenery this north side of the Lawarai is superb. Working parties of soldiers on the top toboggan down, when work is finished, for several miles on their spades."

At this period Russian invasion was a very real bogey, and one of his tasks was to explore every pass on the West and North of

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Chitral by which a handful of Russians might possibly creep over on all fours. These passes were ten, twelve and even fourteen thousand feet high, and the trips were very arduous, although very interesting. Looking back from this distance of time the "bogey" does not seem to have been a very solid fear. Modern conditions of warfare do however greatly alter values.

My father's graphic letters, accompanied by large and marvellous photographs, came when I was of a highly receptive and impressionable age and made Chitral appear to be a very real and romantic country, despite the dour nature of winter in shut-in valleys.

The Sapper officers mentioned most frequently by him were E. G. Henderson, R. H. McDonald and F. E. G. Skey. McDonald was awarded the Albert medal for great gallantry in digging out troops buried by an avalanche during one of the annual reliefs of the Chitral garrison.

Touching native sports, the following is an extract from an Indian paper dated May, 1897 :---

"The Kafirs are noted as great *shikaris*. They are celebrated for the use of the bow, and one and all are adepts in the use of the long one."

The article continues: "There is a story current among the natives that the country of Chitral was the prison in which King Solomon shut up all his most refractory spirits, whom he could not by any other means reduce to obcdience. The legend at all events exemplifies the dread with which natives used to look upon the country."

The accompanying photograph of a cantilever bridge, so common a feature on the N.W. Frontier, shows a bridge over the Laerdal River in Norway, photographed in 1938.

THE BACKGROUND OF THE WORK OF THE REGIMENTAL OFFICER.

(Consisting of a report of an Address to potential officers.)

By " SENTRY."

I HAVE come here to give off some ideas on one part of an officer's job which is not generally explained very fully in any training The officer's jobs really fall into two main sections. syllabus. The first is all that part which is carried out in what you might call "working hours." This includes all your contacts with the men when you are in partnership with them in the corporate life of the The training for this part of an officer's job is, generally unit. speaking, contained in training syllabuses, manuals, and so forth. The other part, which is in many ways almost as important, in fact some people say, as important, covers a very wide and very interesting field, and contributes to such vital matters as the tone of the unit, the relationship between officers and men, and all that makes the difference between a really happy and willing unit, and a comparatively dead show. The whole subject is one which is generally acknowledged and known to be of really vital importance. If you can absorb a few ideas I think it is safe to say that you will be able to make a tremendous difference for the good in the lives of a lot of extraordinarily stout fellows.

The general absorption of the knowledge and experience required for this side of your job comes, for the Regular officer, from a background built up very often over a period of years. Speaking for myself, it took me a very long time before I really got the feel of the men and of the unit, and could diagnose and foresee little symptoms which might possibly cause trouble or unnecessary discomfort and find a way to put things right. I remember at school, as Head of my House, making some really outstanding blobs. Later, in command of a unit on service, and a little later during a more difficult period of peace training, the blobs still occurred and even now I sometimes sweat when I think of them. At that time I remember feeling a certain lack of confidence about ever being able to make a really good show on my own, over a period of years, of a unit, let alone of bringing it up to the sort of standard both of efficiency and of contentedness which I felt was required. When, however, the time came some years later there was really not much difficulty, simply through the absorption of knowledge and background.

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You, unfortunately, are doubly badly placed. You have somehow or other to acquire that background very quickly, and on your ability to acquire it quickly will depend the well-being and probably the lives of the men you are responsible for. On the other hand, that thought should be sufficient to provide you with a stimulus and with encouragement during bad periods when there is a temptation to go slack, give up, and excuse yourself for lack of effort, or worse still, to become self-satisfied.

I think myself that one of the great charms of regimental soldiering is the fact that no matter how few soldiers you control, your power for service is literally never exhausted.

Let us consider now the elements that go towards this background. One important element is a good knowledge of the conditions under which the soldiers live, or may, under different circumstances, be expected to live. Most of you have had some experience, but I hope you won't assume because of that that no further effort or thought is required. On the contrary, it is not difficult to imagine the immensely different sets of circumstances which may completely alter the conditions under which your men may have to live. You should be thinking out the sort of problems that will face them, and be ready under whatever circumstances arise in your unit—through forethought, possibly planning, and possibly training—to ensure that your little packet of men will be in the best possible position to make the best of the worst conditions.

Next, you must have a really good knowledge of men generally, and of your own men in particular, and of the outlook on life of the soldier. Without this you will never be able to get the feel of your unit; neither be able to anticipate troubles and discomforts nor, when they arrive, to deal with them in the best possible way.

Another point is to develop your ability to spot what men are good, indifferent or bad. For instance, the most important is the selection of your N.C.O's. It is to my mind almost impossible to make a fair and good judgment on appearance. An interview lasting for a few minutes is not much better. You can only really choose a good N.C.O. out of the ranks by knowing what to watch for and watching for it over a considerable period.

Then you want to make up your own mind about your manner with the men, so that you can get the best out of them with the least fuss and bother; can keep in sufficient touch with them without in any way being a nuisance to them or risking your discipline through familiarity; and to know when to drop on a man and when to look the other way. In fact, you have to develop the ability to deal easily and in a friendly way with all the little human and administrative problems that crop up and need sensible handling if you are to have a really high-grade and happy unit.

You can probably see that the sooner you can build up for your-

self this background the more peace of mind you will have yourself, and, what is more important, the better will be the discipline and efficiency and well-being of your men. You may or may not get good and sympathetic guidance in getting this background, but that is not nearly as important as you might think, because you can never acquire a background unless you work for it yourself. This is really due to the fact that when a man is leading other men he must exercise his own qualities and use his own knowledge, and he can never be successful if he is just passing on undigested second-hand stuff.

If you decide after listening to a few of these ideas that it will be worth while getting busy for yourself as soon as you get your "pips". I may as well warn you that you are in for a packet of work. This is chiefly because, speaking from my own experience and that of a number of officers with the same sort of outlook, when once you start you find the subject so interesting that you cannot drop it. Having issued this warning I think I can safely add that there is also a considerable reward, probably the biggest reward any officer can get. That is the will of the men to do anything you tell or ask them; and the knowledge in your own mind, as time goes on, that you have helped out a lot of fellows living under conditions which, with all the will in the world, are bound to be difficult.

Now to go on to the sort of efforts suggested. I say "suggested" because part or even most of the effort must be one of thought, and you will almost for certain, if you take thought, be able to improve upon and enlarge the few points I can make here.

First of all, get to know your men at once. The first job is to get name and face perfect. A Platoon Commander can easily do this in a fortnight, a Company Commander can do it in a month or six weeks. Personally, I never found this job of knowing large numbers of men too frightfully easy, but I evolved for myself a system which I found to be of great assistance. All you have to do is to get a small Woolworth's loose-leaf notebook, draw a line down the middle of each page, and keep a page or two for each section or other sub-unit. In the left-hand column put in names, and opposite each name, in the right-hand column, put in three or four word descriptions. For instance :---L.H. column-SNOOKS. R.H. column-SCRUFFY, GINGER HAIR, SPOTTY FACE. At odd moments, having collected your first batch of names and descriptions, use your book as in learning irregular verbs-cover up one side and fit your descriptions to the names, visualizing what you remember of the men. Then do it vice versa, getting a mental picture of the man from your description, and seeing whether you can put a name to it. In building up your lists tackle first the men whom you can obviously easily recognize-the very fat, the very thin, the very tall and very short, the particularly ugly and so forth.

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You can get your names either by asking the man, but do it tactfully, so that he doesn't feel he has made a boob and is "losing his name"; or, when on parade or off, hook on to an N.C.O. and get him to help. I know that it is a very good thing to be able suddenly to address a man by name without ever having asked him what it is. One word of warning—when you have got a nice little list, don't go leaving it about.

Having got name perfect take things a bit further. Get to know each man personally and a little bit about him somehow or other. It may not at first sight seem particularly easy to do this without bothering the men, but you must manage it somehow. As a matter of fact, you will have absolutely countless opportunities provided you look upon yourself not as a member of a segregated gang of lepers from the Officers' Mess but as what you really are-just one member of your platoon or whatever it may be. In my unit, when we were having a Stand-easy on a route march for instance, you would never see the officers gossiping together but you would always see the officers gossiping with N.C.O's and men. Here again some sort of private aide memoire is of great assistance to begin with. Personally, I have always kept a little private loose-leaf book with a page to each man, when I was in charge of only a few; and later, of each of the main categories, such as N.C.O's and potential N.C.O's when I had rather more men to look after. There are all sorts of jottings which it may be worth putting in to begin with, such as where a man lives, whether married, if he has a large family, any little particular failings or good points.

If you decide on such a system don't let it get on top of you. Use it for as long as it is useful. After about two or three months with the same lot of men you can see from your jottings whether there is anybody you may have neglected and therefore don't know anything about. After another month you will probably find that the need for your jottings has passed, and that you really know all that is necessary to know and all you want to know about each of your men.

When you have got to this stage you will have solved a lot of your daily problems. You will know all sorts of implications behind disciplinary charges, requests and complaints and you will know automatically the best line to take with the unit, and with any particular man in any particular situation. There is one word of warning about this. The better you get to know your men, the greater the tendency to judge too charitably, and you may have to be a little on your guard about this, although in general the bigger trust you put in them and the more charitably you deal with them the better; but some men are inclined to interpret charity as weakness, and no matter how close a personal touch you can establish with your unit you must always remember that the efficiency of the unit is the main thing and therefore you must never be led into anything that can be interpreted as weakness. For instance, one of the most unpleasant jobs that one has to do is to tell an N.C.O. whom one knows well and who is a friend, that he has reached his limit and must be passed over. If you can do that and still retain the loyalty and the efficiency of that N.C.O., you will be getting on.

Now the real guts of all that is of course that you must guard against the appalling frame of mind which regards "the men" as a conglomerate huddle of a slightly lower form of life than that represented by yourself. I have purposely put that very unpleasantly as I want to contrast that view with the truth, or what at any rate most good officers consider to be the truth; which is that, properly led, the British soldier as a class is one of the finest and most reliable classes in our community. To lead soldiers properly you simply must solve the problem of evolving during working hours the corporate life of your unit without which it cannot do its job in war, and at the same time, both in working hours and out, get to know each individual so that you can develop and make the most of him and be in a position to help him solve any problem which he may have.

Now to turn to the soldier's puzzles. After you begin to take real interest in your men, or, to put it another way, to take a real grip of your show, you will soon find out, if you don't already know, that most of the soldier's puzzles come from a few quite simple causes, and that the remedy lies in most cases with the unit's officers. With men who are working hard and who have little money to spare, food is really a most important matter. Accommodation, with which you can bracket soldiers' rest and relaxation, is also very important. Pay, coupled with the incomprehensible and frequently untouchable credits, is another. The interesting and profitable use of spare time is another problem. Clothing, washing and hygiene generally is frequently of more interest to the soldier than is recognized; and, of course, leave.

Each of these subjects probably gives rise to troubles for every soldier at one time or another. In addition, many men have particular troubles of their own which you can only find out and remedy or help over by getting to know your men and by their getting to know you and relying on your sympathy and ability to help. In connection with individual troubles I would strongly advise you to make an ally of the padre and possibly of the regimental doctor. But if you do this, be very careful never to bring into official dealings with the men anything you have heard through these sources; nor indeed any confidences which you may be privileged to hear yourself from the men.

Let us deal with the main general causes of discomfort and

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unhappiness. The food question can only be solved by a pretty continuous watch on what actually goes into the men's bellies. Most of you know the differences that exist between the meals served in different units. You get the first-class unit, in which every man really gets enough for his individual needs, and in which the meals are hot, the food is well cooked, and with a reasonable variety. At the other end there is a unit which lives eternally on cold stew, containing uncooked chunks of unrecognizable dead meat. In such a unit there is always the feeling of uncertainty among the men that if, through duty, they miss the normal meal-hour, they may get nothing at all. Now all that sort of thing can practically always be put right inside the unit. The exceptional cases which the men don't mind, particularly if the officers are involved, are in times of stress when you simply have to live as best you can. I have always myself looked on the food question not as the private property of the Messing Officer, but as a matter which is the immediate concern of every commander. The other people are really convenient substitutes, or possibly servants, of the Commander, put in to rationalize the feeding problem. In the same way as visits to your men in hospital always give great pleasure, so visits to meals by Commanders are also much appreciated, and apart from that, are very important. Particularly watch out for your men's interests when you happen to bring them in late. Even in barracks it is absolutely wrong, when you have gone outside the routine, to disappear contentedly to the Officers' Mess the moment your men have been dismissed. The least you can do is to make sure that they are going to get a meal. The right course is to see for yourself that the stuff actually goes into their bellies.

Now to take accommodation. You may think that you are limited absolutely by what is laid down. This is very rarely so and if you bustle round you can generally ensure that your own men are at least better off than anyone else's. There is no harm in entering into a little mild competition in this matter. If you take the trouble you can generally wangle stuff out of the Quarter-Master who, being human, will not stand up against tactful importunity, and who will probably be quick to recognize that your effort is worth a reward, and may even feel grateful for your taking interest in what some people think is purely "his job." Quite apart from wangling extra straw for palliasses and that sort of thing, see that the men themselves make the most of their accommodation. Most of them prefer living reasonably tidily and cleanly, and unhappiness in a barrack-room or tent is sometimes caused from a generally accepted slack standard due to a wishy-washy N.C.O. Again, when moving into bivouacs, billets, barracks, etc., don't consider your job is anything like finished when the men are dismissed. Nothing is worse than to see a lot of officers directing their own domestic arrangements when their men are trying to settle themselves in. Incidentally, when once your men know that you are going to look after them, you will generally find that without any fuss of your own you will have the best place and most comfortable spot for yourself.

Taking pay now. Pay is generally done under Company arrangements and many Company Commanders think of pay as an officers' fatigue. On the other hand, some Company Commanders make a rule of invariably paying out themselves. If your Company Commander does this, your contribution towards solving pay troubles can be made through your individual contacts with the men. If you take the Company pay, don't consider it as a fatigue, but delve into anything that strikes you as odd. If a man gets a shilling or two it is always worth while asking if he himself knows why and if he does not understand tell him to wait until the end and go through his accounts with him and the Pay N.C.O. until everybody knows where they are, or until you can make sure that anything wrong is put right.

Clothing, washing and hygicne generally again need attention. There are few Army units in which hot water is available in sufficient quantities. There are many units in which the supply of even cold water is so limited that the men find it difficult in the time available to scrub themselves enough. In any case the temptation for a scrub under a cold tap in cold weather is not overwhelming. Make sure that things are no worse than they need be, and if they are bad you may have to issue orders. Watch the blankets, and see that they don't get impossibly greasy. If they are bad, press for changes of blankets and for washing. Make sure that the men are not forced to live permanently in damp clothes.

Going on now to a rather more difficult subject, consider whether you can in any way assist the men in filling in their spare time in an interesting way. If you can really make military subjects which can stand exploitation a matter of life and interest to the men, you will find no difficulty in running voluntary classes during out-ofschool hours. Don't try it on Friday, Saturday, or Sunday, but before pay-day is due I think you will find that you will attract willing and interested audiences. The sort of subjects which are important and which can be made really interesting are regimental history, personal experiences in the present and last war (for which you will probably have to borrow assistance), military history generally, and a weekly account of what has been going on in this war. In addition, consider map-reading, prismatic compass work, and if you are up to it, technical stuff about weapons and vehicles used, such as is not taught in working hours. If you can run that sort of show you will be doing much more good than just filling in a few odd hours, as you will be providing men with interesting subjects for discussion, apart from the

normal ones of beer and women, with which I think even the dullest soldier gets bored.

Now I think that if anybody is still awake, I have probably got enough across to indicate the sort of lines of thought which I suggest you should follow up and improve on. If you do think that this general subject of non-parade officer's work is worth thought, and if you really start thinking, I know that you will very soon cover a much wider field than I have done. If you begin putting your thoughts into practice, do so with plain horse-sense, and don't try to force the pace with either yourself or your men. I can promise that if you give yourself up to your unit, as you will find you will be doing, life in the unit is at all times absolutely full of interest and amusement and you will be infinitely more happy and probably far more fit than if you find yourself thrown back on swapping drinks and gossiping about stale and well-worn subjects in your own little personal circle.

Finally, I would like to remind you that I have been trying to indicate how quickly to get that background which is necessary before you can really pull your full weight in your team—company, or platoon, or whatever it is. I have suggested a few of the ways you can get this background—only a few. The curious thing is that when once you have tried out these methods and got your background, you can pull your weight almost at once in a new unit, before you have built up your knowledge of names and so forth. I would like to finish off with a quotation which is—if you think it out—very relevant to all I have been saying, and may pave the way to still further thought. The remark was made by Oliver Cromwell, one of the greatest British leaders and generals. He said something on these lines, "I will have men of conscience, who know the cause for which they fight, and love the thing they know."

TALES OF A MALAYAN LABOUR FORCE.

III.—ALI THE JAGA.

Ву "МАТА КАСНА."

His name was Ali bin Sidin. I do not know where he came from, but he was a man of the sea and we cannot be far wrong in assigning to any one of a number of identical kampongs* scattered along the creeks of the Singapore coastline the honour of being his birthplace. From a distance, any island in the Malay Archipelago presents a pleasant appearance of matt olive-green homogeneity clothing the whole, from the prussian-blue water-line to the very summit of the rounded hillock which is the central feature of each one of them. A closer inspection generally reveals the fact that the dense jungle which covers the island gives way, at the water's edge, to a belt of muddy malarial mangrove swamp at once unpleasant, dangerous and useless. But in places along these coasts the mangrove unwillingly retreats, to disclose a small sandy beach overhung with coconut palms. And here, clustered around a shallow well, you will find the wooden palm-roofed dwellings of a Malay fishing village. On the beach, or riding out at stakes, are the dug-out kolehs or highprowed sampans which form, probably, the principal means of communication with neighbouring communities, as well as the source of the kampong's livelihood. The houses are square and built on stilts of bintangore, and beneath them, and round the piles of red nerai firewood stored there, we might expect to have found about thirty years ago the rotund little coffee-coloured figure of Ali, the son of Sidin, devoting to play those very few carefree years of his youth.

Besides a few banana trees there will be no signs of cultivation, for the Malay is notoriously idle, but the *kampong* must include at least one durian tree and, when the highly-prized malodorous fruit was ripening, it is not improbable that it was here that our Ali gained his first experience of the life of a watchman, posted there as a small boy to ensure that the tree was not raided by evillyintentioned neighbours.

Through what ramifications of officialdom Ali came to be snatched from his native surroundings to be transmuted into an Arm of the Law, I cannot say. But, since he did become a constable in the

* Kampong-Malay Village.

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Straits Settlements Police, there must have been a day when, in company with others like himself, he entered the Police Depot at Singapore and began to assimilate discipline, to learn the use of arms, and to acquire a mass of knowledge of all kinds to make himself a useful implement of the "Pax Britannica." And, when he first set out in the smart white *baju* and dark-blue *sarong* of a police recruit, we may presume that his heart swelled with pride and that his native *kampong* must have seemed to be very far away indeed.

And so our Ali pursued his career, until a time came when he could proudly display upon the sleeve of his grey-blue shirt the twin silver chevrons of a Corporal. But then, suddenly, disaster overtook him and he found himself prostrate on the football field with a broken leg. And Ali's leg mended slowly, and stiff and crooked, so that when he left hospital it was to receive a neatly typewritten Certificate of Discharge and to realize that he was without work or the means of supporting his wife. And that, indirectly, was how I came into contact with the little man. For, as soon as he could, he went off and joined as an ordinary coolie the labour force then working under me in clearing a large estate for Government development. In this act he displayed some courage, for not only, as we have said, is the Malay idle by temperament, but the labour force which he joined consisted almost entirely of Tamils. But, having joined, he swung his axe and grubbed roots with the best of them; until the coming of the invasion. And then he almost came back into his own.

The land on which we were working had been for generations the home of countless families of squatters and we had encountered the greatest difficulties in persuading these simple Chinese folk that the land and everything on it was now no longer theirs, as it was wanted by "the Company." Government in the colony is still "the Company " to the masses, although it is eighty years since the Honourable East India Company ceased to exercise any authority in the Straits Settlements.

By dint, however, of argument and explanation oft repeated; of occasional careful payments in compensation; and of the bullying of a remorseless Chinese bailiff, we had eventually cleared the area of its pathetic population, even though we had sometimes found it necessary to drop a tree across the corner of a house and break in the roof to show that we were in earnest. But as soon as we started in to fell the giant *tembusus* and flowery *chembagahs*, the rubber and coconuts, and the mangosteen and *rambutan* trees, and to set about clearing the lac palms, guavas, and bananas which generations of their families had cultivated, back they came again.

At first, they drifted over in families of two's and three's, then in their hundreds, until there must have been fully a thousand of them there—men, women and children—chopping and cutting and carrying off loads of wood to their new homes. It needed a squad of armed police to clear the ground this time and, when it was done, we sought among our coolies for a *jaga*—a watchman—who should remain on duty when the labour knocked off. Ali it was who came forward as an ex-policeman to claim the job and thus he came into the unenviable position of a lone Malay representing "the Company's" interests against a mob of dispossessed Chinese squatters.

He was a short, stocky, little man, with an almost spherical bullet-head, thick negroid lips and the snub nose and dilated nostrils of his type. Off duty, dressed only in a brightly-checked sarong, you found him a mass of rippling muscle the colour of fumed oak. When he wanted to feel smart, he forced his broad, splayed feet shamefully into a pair of villainous, pointed, European dancing shoes, donned a white baju, and planted a black velvet songko on his head.

One hot, steamy morning came Ali to me, smartly turned out in his khaki drill uniform and carrying a murderous-looking bamboo truncheon. "Tuan," said he, saluting, "there were two Chinese men fighting with axes." "What did you do?" I asked. "I have taken the axes away from them," answered the little man, like a nurse speaking of naughty children. Together we crossed the airy brow of the hill and descended into the moist heat of the valley beyond. There, beside a huge fallen tree, stood two brawny Chinese shouting at each other while a third, dressed only in a cotton singlet and black trousers, straddled the log with a saw idly across his knees. The trouble was, we elucidated, that this tree was especially suitable for making dart boards, that the man with the saw had a permit to remove the timber, and that each of the other two claimed the sawyer as his servant. Here was opportunity for a Solomon. " The servant shall decide," I said solemnly, "which of the two is his master." This proved sufficient, as one of the men at once took up his gunny-bag coat and sidled off, muttering.

So day by day Ali strode about the estate, here beating unlawfully but effectually a Chinese for stealing mangoes, there driving off single-handed half the womenfolk of a kampong from our wells, while from time to time he might have been observed, a thick, sturdy, little figure, herding a few head of cattle or a dozen goats to the local pound. Scarcely a day passed without his appearance to report some incident of the sort. Perhaps it would be with a basket full of sweet-smelling chembagah blossoms, such as sell in the markets for a cent a piece, which "I took from a Chinese woman in the valley by the house of the madman"; or with a bony, wrinkled Chinese, firmly grasped by the wrist, accused of chopping wood " nearby where the old woman once set her dog at the Tuan," who was forthwith marched off to the local police station. I remember a breathless afternoon down near the new reservoirs, where the sun beat up relentlessly from the newly-turned white

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clay, when Ali came running to explain that he had in the hand-cart over there on the track a young Tamil who had hit himself on the head. Ali always spoke too quickly on these occasions and I found it difficult sometimes to follow his accounts, but in due course it appeared that he had seen the unfortunate high up in a *rambutan* tree gathering bunches of the reddening spiky fruit. Ali had ordered him down and, on receiving a rude reply, sent his club hurtling up into the branches. The club struck the man, who lost his balance and fell on to his head forty feet below. We hurried him off to hospital, where he died. We never heard any more of it, and why should Ali have minded? For the Tamil to the Malay is the "orang *kling*"—a murderer by birth.

By this time Ali was far from popular in the district and, as may be imagined, it was not long before some attempts at retaliation were made; so that when, suddenly, he appeared completely bald before me, it was to report that some spiteful Chinese must have put something in his water-butt to make his hair fall out! Ali lived under the shadow of two tall scaling-wax palms, in one room, at the end of a low *atap* shed which served at that time also as store and office. One night he awoke to the sounds of someone breaking into the adjacent store. He seized his club and made for the door—to find it pegged on the outside ! Fortunately, he had an axe with him and the lonely night thereupon resounded to the blows of our watchman fighting to get out of his room while the thieves raced to break into the store next door. Eventually their nerve broke and they fled, so that when Ali emerged, covered with chips of *seraiah*, it was to find his store damaged but still intact.

Then it was, I believe, that Ali began to be frightened, and I must say I don't blame him. But we had had trouble enough in getting his original appointment confirmed, so there was little chance of doubling the watch at this time. All the authorities said was, "What are the police for, anyway?" But I decided then to start a log-book so that we should at least have a record of what our watchman had done. One of the earliest entries is typical of many. "At 2.45 a coolie arrives and wants to know where his bicycle is. I, Ali bin Sidin, give answer, 'I am here to look after the Tuan Majesty's property, not your rubbish'." And in similar terms posterity can now read of Ali's discovery of the secret working of an unknown sand-pit on the Government land, and of the prosecution and conviction which he secured. And when it so happened that I became personally involved in any of his adventures (as, for example, when he and I gave chase on bicycles to a lorry full of stolen timber) his descriptions of my share in the day's work exceeded the bounds of all decent exaggeration and became positively epic.

At first he wrote always in Malay and I used to find his daily

peroration a useful aid in my study of his language. From it I learnt the depth of his hatred for the Tamil, and of his despisal of the hardworking Chinese. Under his phonetic pen the Locomotive Shed became the Lokor Sit and the Pump-house the Pamass, but from his diary I learnt in due course much of human nature. One of his early English efforts, I remember, was headed " Report of harrowing dead pigs in the nursery." It appeared that Ali had surprised a Chinese at dawn burving the bodies of two dead pigs in the Government nursery garden. Being Sunday and none to advise him, he had marched the culprit off to the police station and was furious at the attitude of the Inspector there, who had declared repeatedly that it was no crime to bury dead animals. The little man, however, was not satisfied with this outcome of his effort and illegally detained his prisoner all through Sunday in order to bring him before me on Monday morning. What he expected me to do I don't know, but between us, with the bailiff acting as interpreter, we persuaded the Chinese to take his corpses away.

Walking in the nursery garden one day, I came upon Ali firmly grasping a small howling Chinese boy by the car. To one side stood the old Tamil head gardener with a pathetic bunch of withered seedlings in his hand. The small boy had been caught in the act of pulling them up. I ordered Ali to release the boy and, making a furious gesture to "be off with you," let forth a flooding ululation which I thought might pass for a fair imitation of the average Cantonese coolie talk. Neither Ali, nor the gardener, nor I, spoke a word of Chinese and the little boy was far too unhappy to do anything but run away the moment he could. So I was quite safe, and Ali duly recorded in his log book (proudly, I thought) that the *Tuan* had admonished the culprit in Chinese !

There is a saving in Malava that none sleeps so sound as a watchman, and I am inclined to believe that Ali, with the fear of a Chinese knife between his shoulders, latterly spent most of the hours of darkness safely in his bed. I believe, too, that it was his broken nerve which invented the tiger. Now Singapore is an island, fairly densely populated and more than three-quarters of its area is town, village, or under cultivation. So that, although there is a possibility of a tiger swimming the Straits of Johore and landing on the island, the chances are nowadays sufficiently remote for reports of their presence to call for very sceptical investigation. Several times had Ali mentioned that he had seen on the estate a large tiger which loped off into the jungle on his approach, and he called coolies to substantiate what he said. The Overseer declared that they had been seeing a dog, but the Chinese bailiff asserted that the evicted squatters knew a ghost tiger, who formerly lived in the hollow trunk of an aged *tembusu* tree which we had felled. But Ali stuck to his story, and appeared breathless and bathed in perspiration at my

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bungalow a few nights later to report that the tiger was again on the estate. This time he had been, so he said, patrolling in the vicinity of the nursery garden when he had become aware of two large red eyes staring at him out of the dark. He clapped his hands and made a noise but the great beast had not moved. So Ali had run, with the tiger bounding after him, to his house, and shut himself up, to remain there trembling at the snorts and heavy breathing of his pursuer outside. At length the animal had gone away, and now the Tuan must come with his gun, and Ali must in future have his own rifle. But the Tuan had no gun, so he sent the poor frightened man away to report the matter to his comrades, the police in the kampong down the road. But I suspect that Ali feared their ridicule as much as a Chinese knife and never went near the police station at all. In the morning we went out to look for pug marks, but we saw nothing but the scratchings of his fowls and the tracks of a snail or two in the sand round Ali's house, so it must have been the ghost tiger after all.

In the end he answered the call of the sea, tendered his resignation from "the Company's" service, and embarked as a serang in a cable-ship. His last day with us was typical. At 6.30 in the morning, in a steamy downpour of rain, Ali recovered a newly-born Chinese baby from the jungle and carried it on his bicycle to the police station. At noon he appeared with a tough-looking Hokkien coolic, whom he had seized in the act of removing some "railway iron " fishplates and bolts—from the yard. His final act was to take down, in the face of a menacing crowd of strikers, a Communistic poster depicting a mob of Chinese pursuing a hatless white man down the road. This he handed personally to me with the words "very evil," and then with much ceremony presented me with his heavy bamboo tongkat "as a memento of our service together." With this characteristic reminder of the Malay's independence of spirit, he was gone.

There must be many like him, great-hearted, staunch little cogs in the Imperial machine, who serve unseen and leave unrecognized, to die forgotten. But I cannot forget Ali bin Sidin and his brave lone guardianship of the *Tuan* Majesty's property. Secretly I like to think that it was to us that the Malabari crew of a pile-driving winch referred in the lilting chanty which they were singing as I passed on my way home a day or two before he left us.

> " A—ehlo Eelo (They sang) Soon the sun will be set. The King is now going to his castle. Only the watchdog remains in the courtyard."



Maj Gen Sir Godfrey Williams KCIE CB
MEMOIRS.

MAJOR-GENERAL SIR GODFREY WILLIAMS, K.C.I.E., C.B.

ON the 3rd September, 1940, Sir Godfrey Williams died at the home of his son-in-law, Captain C. J. Wheatcroft, J.P., in Wirksworth. The General had reached the age of 80. Three daughters survive him, Dr. Mary Leslie Smith, M.B., B.S., wife of Colonel Leslie Smith, R.A., Mrs. Hamilton, wife of Colonel F. A. Hamilton, O.B.E., J.P., D.L., and Mrs. Wheatcroft. A grandson, 2nd-Lieut. A. J. Wheatcroft, is in the Corps.

Godfrey Williams was born on the last day of 1859, at Bitton, Gloucestershire, of a well-known Monmouthshire family. He was the fifth son of William Addams-Williams, Esq. Their home, Llangibby Castle, has belonged to the family since 1555. An ancestor fought in the Civil War and many others have served in the Army and as High Sheriffs. He was educated at Sherborne School, whence he passed direct into the Royal Military Academy in July, 1876, his principal subject being mathematics, in which he came out first. His commission in the R.E. was dated 31st January, 1878. He represented the "Shop" against Sandhurst at Rugby, and at Chatham he played for the R.E. against Oxford in the semi-final of the English Association Cup.

After the usual two years at the S.M.E., he joined the I.G.F.'s office, London, in January, 1880, and was employed surveying sites for forts around the capital. He was also appointed Assistant Secretary (under Major, later Sir Thomas, Fraser) and a year after became Secretary to the Committee on Siege Operations.

His Indian career began in December, 1881, when he was posted to the Indian Establishment, arriving in Roorkee two months later. His first job was the construction of a 130-yard tunnel for the Mussoorie municipality. In August, 1882, the future D.G.M.W., was posted to Military Works Services, and carried out his initial duties at Rawal Pindi and Peshawar. In 1884, he was sent to Cherat in charge of construction of barracks and of a hill road from the Plains.

In 1885, Lieut. Williams served in his first campaign. He was ordered to Egypt to join a Labour Corps of 800, who were sent to build the railway from Suakin to Berber, but the construction was abandoned and a few months later he returned to India, having been mentioned in a letter to the Government of India, which spoke of his judgment in dealing with men. He gained the Suakin Medal and the Khedive's Star,

From November, 1886, to April, 1887, he officiated as Executive Engineer at Sibi in Baluchistan. He then joined the I.G.F.'s office in Simla, where he remained until 1892, when he returned home on furlough and underwent courses at Chatham. He went back to India in November, 1893, as Executive Engineer at Peshawar.

In April, 1895, Williams, now a Captain, was posted as Field Engineer with the Chitral Relief Force, and was selected to build a great suspension bridge over the Swat river. It was 964 feet long and included, with 34-foot iron towers, one centre span of 220 feet. The troops at his disposal were the 6th Company, Madras S. and M. and some civil artificers. Of this bridge Mr. Winston Churchill writes in his *Malakand Field Force*: "Here the road crosses the Swat River by the fine suspension bridge which the fort guards. It was constructed in 1895, during the operations, in about six weeks, and is a very remarkable piece of military engineering." General Stedman, at that time G.O.C. Lines of Communication, wrote: "I believe that engineering on active service in the field has never reached a higher development." Captain Williams received the Chitral Medal and was mentioned in despatches.

Rejoining Military Works in the following September he was transferred to Rawal Pindi and obtained his majority in September, 1896. The Swat valley campaign had affected his health and in 1897 he came home on sick leave. He returned to India at the end of 1899 and was this time posted to Bangalore until December, 1902, when he was transferred to Simla as Deputy-Director-General of Military Works, and served in that capacity as Lieut.-Colonel and Colonel, until March, 1909, when he was appointed C.R.E. Lucknow, and a year later C.R.E. Quetta as well as Secretary, P.W.D., to the Chief Commissioner in Baluchistan.

By this time Colonel Williams had reached the high appointments of the Military Works Department. In July, 1912, he was transferred to Simla as officiating Director-General, Military Works, and he subsequently became permanent D.G.M.W. in 1913 with the local rank (substantive in 1917) of Major-General.

General Williams happened to be on leave in England when the European War broke out, and at once returned to his work in Simla. A year later, in August, 1915, he joined the Mediterranean Expeditionary Force at Anzac as Chief Engineer to the Australian and New Zealand Army Corps. The new Chief Engineer arrived just as the troops, who composed the second great Gallipoli landing, had come ashore at Anzac and Suvla. Among the dispositions to be made, none was as vitally important as the provision of water in those burning days, when the troops, the greater part of whom



Chakdarra Fort and the bridge across the Swat River.

(From a drawing by Major E. A. P. Hobday, R.A.)

By kind permission of Meases, G. Bell & Sona, Ltd.

Chakdarra Fort opposite page 552

were just out from home, were to be asked to advance into a wild and waterless country. Very unfortunately, every evil spirit of drought appeared to be in league with the enemy. The wells on the Peninsula had dried up; the water ship conveying Nile water for the supply of lighters to the beaches got "lost"; the one miserable, second-hand, third-class pumping engine, which the British Empire seemed to think was all it could supply for this critical campaign, broke down five times a day, and Sir William Birdwood, the Anzac Commander, had been forced to wire Sir Ian Hamilton, C.-in-C., M.E.F., that if water were not forthwith delivered at Anzac beach, he would be compelled to embark his troops from the Peninsula instead of accepting new divisions. The lost ship was located in the nick of time, but the misguided engine was a tougher proposition and in the end the attack from Anzac had to be launched by men carrying half-filled water-bottles.

Water, therefore, was the Chief Engineer's perpetual nightmare. A 50,000-gallon iron reservoir had been man-handled a couple of hundred feet up the hillside, but when erected, gave signs of subsidence. Each morning General Williams, just then a sick man, rose betimes to make his own measurements and to take adequate precautions to prevent the edifice sliding downhill again. No important effort, whether by British, Australian or New Zealand engineers, was made without his critical powers and his Indian experience being effectively brought to bear upon it.

The staff at Anzac were sorely grieved but not surprised when, on September 7th, their Chief Engineer became Engineer-in-Chief to the M.E.F. General Williams' task then became that of the Children of Israel in Egypt-to produce bricks without straw, for the engineer depots of the three Corps, at Helles, Anzac and Suvla, resembled Mother Hubbard's cupboard. Aeroplanes let us more or less alone, but enemy submarines were largely instrumental in the decision of General Sir Charles Monro, who joined later as C.-in-C., to evacuate the Peninsula. Monro knew his E.-in-C.'s work in India and the two officers had great confidence in each other. General Williams had devised a scheme to distil sea water for drinking; an aeroplane wrecked the plant the day it was erected. Plans were also made to haul water, food and munitions up to the trenches, 400 feet above the sea, by means of two long aerial cableways; a submarine sank the boat bringing half the plant. Even the water-diviners. and the well-sinkers brought over from America failed the E.-in-C. And so, on December 21st, the evacuation of Suvla and Anzac took. place, and G.H.Q., which had been living on the island of Imbros, rehoisted its flag at Cairo.

At the end of January, 1916, the M.E.F., now renamed the Egyptian Expeditionary Force, opened up again at Ismailia, on the Suez Canal. Once again water was the E.-in-C.'s principal thought, for the Commander-in-Chief, Sir Archibald Murray, decided to lead his forces across the desert of Sinai to attack the Turks in Palestine. To do this, a railway from Kantara to the frontier was day by day carried forward and, along with it, a great pipe-line, which carried water from the sweet-water canal. This was pumped across the bottom of the Suez Canal and then forward into the desert. Sinai itself, through the urge of the Engineer-in-Chief, supplied far more water by wells than ever was obtained by Moses.

In addition, Lord Kitchener had decided to defend the Suez Canal by a chain of forts six miles or so east of its whole length. Each fort had to be served by a pipe-line, a desert road, and sometimes also by a light railway; the forts had to be provided with engineer material, more especially matting from the Sudan, to meet the difficulties of revetment in sand. Besides all this, it was General Williams' frequent business to confer with the French engineers of the Suez Canal and with those of the "Force in Egypt," led by Sir Murdoch MacDonald. The provision of officer personnel for places so far away as Salonika, fell to him for some time to arrange.

The Engineer-in-Chief got away from his office as much as he could, sometimes to accompany the Commander-in-Chief on inspections of the desert defences, more often on his own visits to the engineering works along the canal. It was a great experience to accompany him on these and to note the quickness of eye and unerring verbal examination, which was formidable enough to the resident engineers. On one occasion while going up the canal to see the pumping stations, General Williams arrived at Ferdan. "What is this?" he asked, pointing to the number, 616, stamped on a small casting. " That, sir, is the diameter in millimetres of the pipe," was the ready reply. " Thank you," said the E.-in-C. and went on to the next station, Ballah. Again he noticed the same casting. "What does 616 mean, please?" he said to the resident engineer. "Oh, that sir, is . . . the height our pump will lift to." Again, "Thank you," and the General continued his journey to Kantara, where was an exceptionally large pump. "I wonder if we can find that casting again," he murmured, and sure enough he found it. "Can you please tell me . . . ?" "Oh, yes, sir, that is the pounds per square inch pressure it will stand." "I rather think it's the maker's number for ordering," the General remarked, adding kindly, " but you weren't to know that."

In May, 1916, at the request of the Commander-in-Chief in India, Major-General Williams was ordered to return and take up his old post as Director-General of Military Works. In that appointment he remained until March, 1919, when he went on leave prior to retirement. For his service in Gallipoli and Egypt he was three times mentioned in despatches, as well as twice more later for his work in India. He was appointed C.B., in June, 1916, and K.C.I.E., in June, 1918.

No account of Sir Godfrey Williams' career in India would be complete which omitted mention of his dramatic fame in the early years of the century. In 1908, the Simla Amateur Dramatic Club made him a presentation, "a small appreciation of your valuable services to the Theatre as actor and Hon. Secretary and Hon. Treasurer from time to time." He was President of the club 1917-18. His powers of impersonation and mimicry burst out occasionally at official conferences, causing them to gain in brightness, if they lost in solemnity.

It may be of interest to officers who know India and Egypt to mention a letter from Lieut. Williams to his father in 1882. In it he complains of the lack of scope in Military Works, comparing it unfavourably with a career in the Sappers and Miners. "Every petty piece of work," he writes, "must be measured personally by an officer : no one lower down can be trusted not to take bribes from contractors." Again, "I have to apply for leave to do the most minor repairs for fear the scanty allotments should be exceeded." But he took a different view when he became Director-General of Military Works and would often speak of the immense experience his long career had given him.

On 14th October, 1918, General Williams presided at the U.S. Club, Simla, at the farewell dinner to Sir Michael O'Dwyer, on giving up the Lieutenant-Governorship of the Punjab. His own farewell dinner at Delhi on 24th February, 1919, was presided over by Sir Charles Monro, and attended by many famous names.

Sir Godfrey Williams married, in 1889, the daughter of T. Blewitt, Esq. Lady Williams died in 1930. In his retirement the General lived for many years in Monmouth. His mind, alert to the end, possessed a wonderful power of cross-examination which separated the wheat from the chaff. He would have made a great judge. He was a J.P., Deputy-Lieutenant of Monmouthshire, a member of the Governing Body of the Church in Wales and for some time was the Treasurer of the Llangibby Hunt and of the Caerleon Archæological Society. All this time he lived the life he loved best, in his own countryside, which he knew and cared for so well, the much-loved friend of countryman and townsman alike, and a shining example of modest greatness and unremitting goodness of heart. He is buried in the churchyard at Llangibby.

E.N.M,

[DECEMBER

MAJOR-GENERAL SIR HUBERT A. A. LIVINGSTONE, K.C.M.G., C.B., COLONEL COMMANDANT, R.E. (retd.).

HUBERT ARMINE ANSON LIVINGSTONE was born on the 19th August, 1865, at Avranche in France, the son of Jaspar Hall Livingstone, Esquire, of New York, Secretary to the American Ambassador at Madrid, and Matilda Anne Cecilia, daughter of Sir John Morris, Bart., of Sketty Park, Glamorganshire. He was commissioned 2nd-Lieutenant, Royal Engineers, on 9th December, 1884.

Very few people had the privilege and pleasure of really knowing Livingstone well, and appreciating him fully, because fundamental features of his character were modesty, shyness, and great reserve, qualities which he endeavoured to hide by assuming among casual or official aquaintances an easy, genial, offhand manner, which, however, admitted only very few people to further aquaintance, and the loss was theirs.

In fact he was definitely not what is known as a "good mixer." In his modesty he did not believe his own accomplishments, talents and thoughts could interest others, so he kept a screen between himself and the world.

Few men were so devoid of any self-seeking or place-hunting motives, and when he observed these in others he reacted strongly against them.

Many of his associates possibly thought they knew him, but without realizing the depth of his character, thoughts and talents.

A friend who was closely associated with him and fully admitted to his companionship has written the following very true appreciation of him. "Essentially a man of action, General Livingstone's rapid decision was a notable characteristic. To those however who had the opportunity of hearing him state his reasons it was evident that his decisions were based on a comprehensive knowledge and a keen intellectual survey of every factor bearing on the problem. It was therefore natural that his decisions were final, and, once taken, were put into action without delay. The fact that they were frequently made so quickly is a tribute to the forethought bestowed upon every matter that interested him.

"He had great ability and patience in explaining involved problems to others less aquainted with the facts. And yet he was very modest as to his own opinions and invariably stated them with a charming diffidence."

To this however one must make the exception that in official



Major General Sir Hurbert A livingstone KCMG CB

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business his subordinates found no trace of a "charming diffidence." On the contrary, they received a very clear and direct order given in a manner that made it quite obvious that it must be executed promptly and with efficiency. One may also add that not only was he a deep thinker, but his brain was unusually quick and active.

Another outstanding characteristic was the fact that he was essentially an "outdoor man," keenly interested in nature and the ways of birds and animals, of the habits of which he was a very close and knowledgeable observer. Hence his attraction to, and attraction for, other outdoor men in every walk of life, and notably amongst the humbler members of the outdoor fraternity, farmers, gamekeepers, etc. From these have come some of the most sincere appreciations of Livingstone and sorrow at his departure.

His upbringing at Avranche and at Pau in France for the first fourteen years of his life undoubtedly had a great effect in moulding his outlook on the world and his character. It certainly implanted in him a deep love of France and endowed him with a thorough knowledge of the French language which was of the utmost value to him and to others throughout his career. From Avranche he went to King's School, Canterbury, which incidentally claims to be the oldest school in England. His parents moved to the Isle of White. After fourteen years in France he must have found his environment in an English school very strange. Doubtless we have here the clue to that protective reserve with which he shielded himself throughout his life, also to his diffidence as a " mixer."

From King's School he went to the R.M.A., Woolwich.

Physically and mentally he was a fine and handsome man when he joined the Army. The accomplishment of the work and duty required of him came easily. His talents enabled him to complete his work with great efficiency in a fraction of the time required by most men. So easily, in fact, that many thought he did not work.

He had the very necessary faculty of getting good work out of his subordinates, and he never made or did unnecessary work. He did not "keep a dog and bark himself." He took no trouble to make a show of the good work he was doing, or to explain to anyone that he accomplished work, although they did not think so. He therefore had more time than most for his outdoor interests and pursuits.

With this appreciation of his character and capacity we can now follow him through his career.

Having completed his Y.O. instruction at Chatham, he was postedin 1887, to the 23rd Field Coy. at Aldershot. His means enabled him to keep two hunters in Warwickshire during the hunting season. When horses and not I.C. Engines provided officers with the necessary mobility for the efficient performance of their duties, hunting was recognized as an important part of their military training.

From 1890 to 1895, he served in Natal, where we may be quite

sure he had plenty of opportunity for outdoor life and shooting, a very favourite sport with him.

From 1898 to 1899, he was Adjutant of the 1st Lancs. R.E. (Volunteers), Liverpool. On the outbreak of the South African War he was ordered to Natal, where he was appointed Assistant Director of Railways, graded as A.A.G. His arrangements for the repair of Railways damaged by the enemy were very successful. He was promoted Major on 1st October, 1901; for his services in the South African War he was mentioned in Despatches and rewarded with the c.M.G. In 1903, the South African War having terminated, he took over command of the 12th Field Coy. at Harrismith, where he enjoyed the outdoor life and sport and found himself therefore congenial to the Boer Farmers.

On return to England in 1904, he was posted to the command of the R.E. Field Depot at Aldershot, where he arrived with three polo ponies and two shooting dogs.

Promoted Lieut.-Colonel in 1909, he spent two years as C.R.E. Singapore and then three years as C.R.E. Forth Defences, Scotland.

In 1914, he was appointed C.R.E. of a Division, with which he went to France in 1915, and was wounded in the arm, from which he fortunately made a complete recovery.

In France he had earned the confidence of his Divisional and Corps Commanders in the construction of defences.

In June, 1916, he arrived at Salonika to take over the appointment of Chief Engineer of the Army there (later Engineer-in-Chief and later still of the Black Sea Army also), an appointment which gave full scope for his talents and capacity.

The man who in peace-time appeared to be somewhat easygoing, (though as I have explained, this was a superficial view), was in war a tiger for getting work done promptly and efficiently. In fact he was undoubtedly a hard taskmaster in the interests of the energetic prosecution of the war, which he ensured.

An officer who was on his staff writes: "General Livingstone was a strict disciplinarian and insisted on smartness, alertness, and, above all, efficiency in all officers under him. He had a flair for choosing his immediate subordinates and no compunction in changing them if necessary. He gave them full scope to do their work without worrying them with details, so that he could have a clear general picture of all the services under his charge. He sought out brains and efficiency wherever they were to be found and pushed on to Lieut.-Colonel's rank and appointment as A.D.W. an experienced mining engineer that he found among his temporary officers. An Italian civilian engineer also became a temporary R.E. Captain. With foresight and organization he secured a most adequate reserve of engineering stores and material that was fully utilized in the final advance. He was indefatigable in visits of inspection, with an

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excellent memory of all he saw. He was not sociable and never to my knowledge attended a concert or show given by the troops. Undoubtedly he was acutely shy. Sometimes he would ask a Senior R.E. Officer to dine to discuss work. He would not accept invitations to dine out and rarely issued any. Very occasionally he departed from this rule by inviting some French Officers. He was a great lover of France and everything French, speaking the language fluently without a trace of English accent. In spare moments he read French literature aloud. When entertaining French Officers he was an excellent host, seeing himself to the proper preparation of the food and wine, busily occupied in attending to his guests. As the evening wore on the conversation became brilliant. He was always seeking information by questions but it was often thought that he knew the answers to the questions and was merely trying out the informant. A first-class minute writer-short sharp sentences like hammer blows with just a touch of caustic wit."

To this one must add that by driving his officers and men hard he undoubtedly produced great results for the benefit of the Army. His zeal to have none but the best in command of Units caused A.G.7 to write to him "You can't expect to be given all the swans." At one time he appeared to be pushing this principle too far, unsettling Units by perhaps too frequent changes of the C.O.

Livingstone had arrived at Salonika at the moment when the Army made a big unopposed advance to take over a large area of country, in which the British occupied a front of 90 miles of hilly country intersected by three broad valleys. To readers of this *Journal* one need not expatiate on the amount of work that immediately devolved upon the Royal Engineers for the construction of defences, for communications radial and lateral, bridges, water supply, hutments and other accommodation, while economy in shipping space for engineer stores, plant and material necessitated a great deal of improvisation and development of local resources. It was this difficult situation that Livingstone tackled with outstanding success, which gained for him the confidence of the Commander-in-Chief.

He fully earned and deserved the rewards he received for the war, viz., promotion to Major-General on 1st January, 1918, K.C.M.G. and C.B.

After the Armistice he moved to Constantinople as Engineer-in-Chief of the Army of the Black Sea, in which capacity he continued until early in 1920 he returned home, and retired in 1922.

In 1920, he married Mabel Beatrice, daughter of the late Mr. and Mrs. Charles Lansbury Tarry, an exceedingly happy marriage. In 1928, their son John Morris was born, in whom Livingstone took the greatest interest, fixing his hopes upon him.

On retirement he had settled at Andover, and enjoyed an outdoor life, supplemented by an annual visit to his friends, Sir Humphrey and Lady Leggatt, for shooting in Scotland, where, as usual, he made a large number of friends among all classes of outdoor men, but especially among farmers and gamekeepers, "gaining their respect and affection by some quite indefinable influence, such simplicity and almost silent modesty in word and deed." Sir Humphrey calls him the most "dependable" man he ever knew.

"In the shooting he was completely unselfish, caring most for the hills and scenery, and the habits and flights of the birds. He knew by instinct which side of a hill or rock to go, he knew which way a bird would fly."

In his retirement he avoided all "functions," not even attending the batch dinner on their 50th anniversary.

The defeat and collapse of France in June, 1940, was a truly mortal blow to Livingstone, whose boyhood, spent in that country, had given him a lifelong interest in and affection for that land and for its people. He survived this disaster for three weeks only, and died on 9th July.

H.L.P.

All Reviews of Books on military subjects are included in the provisions of K.R. 547(c) (1940).

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library at Brompton Barracks, Chatham.)

ALLENBY-A STUDY IN GREATNESS.

The biography of Field-Marshal Viscount Allenby of Megiddo and Felixstowe, G.C.B., G.C.N.G., by GENERAL SIR ARCHIBALD WAVELL, K.C.B., C.M.G., M.C., Commander-in-Chief, Middle East.

(George G. Harrap. London, 1940. Price, 18s.)

This volume describes Lord Allenby's boyhood, military life and campaigns up to the year 1919. The story of the last eight years of his life still remains to be told.

His friends could not have wished for a more competent pen to write the military portion of the biography, for as one of his staff during the Palestine Campaign, Colonel (as he then was) Wavell had great opportunities to study the character of his Chief. His book shows that he must have earned not only the confidence but the close friendship of the man who extended that privilege to so few. He gives us not only an insight into every aspect of Allenby's character, but combines with his study an interesting account of all the fighting in which he took part.

During the years from 1882 onwards which Allenby spent in South Africa events were occurring of the greatest importance at a critical period in the development of that country. General Wavell refreshes our memory of the long struggle between Boer and Briton for the mastery. He passes on to the reorganization by Lord Haldane of the British Army after the South African War, and reminds us of the share Allenby took in the training of the Cavalry during the years before 1914 when Inspector-General of Cavalry. On the outbreak of the European War he commanded the Cavalry Corps. General Wavell defends him against the critics who belittled his great services in the covering of the great retreat. Later, when in command of the V. Corps, Allenby was blamed for incurring unnecessary losses in his endeavours to recover lost ground. General Wavell points out where the responsibility lay. When the critics, and even the Official Historian, suggested that Allenby was not at his best in the command of large infantry forces during the Battle of Arras, General Wavell is able to show that he was not given the troops which would have enabled him to exploit the great and almost unexpected results of his brilliant victory on April 9th, 1917.

Fortunately there were persons who still believed in Allenby despite his detractors. Allenby was in his element as an independent commander. General Wavell describes the reorganization of the troops in the Middle East when he appeared on the scene, and devotes the last chapters of his book to a masterly account, though necessarily brief, of the campaign in Palestine which led up to the final victory and set the scal on Allenby's reputation as one of the greatest of cavalry generals and a great Commander-in-Chief.

"My aim," writes the author, " is to leave on record, while memory is fresh and "many of those who knew him well are still alive, a portrait of Allenby as a man "rather than to describe in detail his achievements in war and peace. . . . His "character was of such truth and strength that it can serve as a model, and yet of "such humanity—rough, violent humanity at times—that it can escape the aversion

" that most people feel towards anyone held up as a model."

General Wavell has most certainly achieved his aim. He goes at some length

into the details of Allenby's early life and education, and rightly so, because it enables him to trace the effects of that education on his career and enables us to understand how it came naturally for Allenby to get on well with our Allies and later to pass so easily from soldiering to the tasks of civil government and administration.

His friends who read the book will feel that the author has perhaps unwittingly laid too much stress on Allenby's failings. He refers too often to the "rough, violent "humanity" side of his character and to the "outbursts" which earned him the soubriquet of "The Bull."

It is devoutly to be hoped that Sir Archibald Wavell will be able to complete the biography so well begun.

Allenby was not intended for a military career. On the advice of a friend of the family, who afterwards became Bishop Welldon, he was sent to Haileybury and, not unnaturally—in view of the School's connection with India—made up his mind to try for the Indian Civil Service. Competition for the I.C.S. was very severe in those days and he left Haileybury, where he had been in the Sixth Form and a "School" Prefect, to cram at Wren's. At his second attempt he just failed to get in, and immediately went up for the R.M.C., Sandhurst. Passing in fifth, he became in due course an Under-Officer, and passed out with honours. He was commissioned in the Inniskilling Dragoons in May, 1882.

Military life came casy to him. He looked every inch a soldier: he could ride and shoot and fish and sail a boat. He had always travelled abroad with his parents in the holidays and had learnt French. To improve his knowledge of that language he had spent a couple of months at Saumur, close to the famous Cavalry School, and made many friends. He retained a warm feeling for the French all his life.

Within a year of joining the Inniskillings in Natal, Allenby was having his first experience of soldiering under strenuous active service conditions in Zululand, keeping the peace between the natives and preventing encroachment by the Boers in the north. Thence he accompanied his regiment in November, r884, to join the First Bechuanaland Expedition under Major-General Sir Charles Warren, who had been given the task of ousting from Bechuanaland certain Boer freebooters who had, in defiance of treaties, set up two small independent republics in Stellaland—round Vryburg—and in Goshenland further north—and to secure the one road to the north between the Transvaal and the Kalahari Desert. A few months earlier, the Germans had proclaimed a protectorate over what was afterwards known as German South-West Africa, and it was the fear that they might join with the Transvaalers and hem in the Cape Colony on the north that had determined the British Government to intervene with Imperial troops.

"Though there was no fighting in either Zululand or Bechuanaland the experience of these two years must have been invaluable to Allenby. He learned the conduct of the minor operations of war . . . he learned the care of man and horse on the march and in bivouac under rough conditions of climate and country; and he learned under skilled and practised guidance. Sir Charles Warren had had previous experience of colonial warfare and was a prudent and capable soldier, so that his expedition was thoroughly well organized and run. . . ."

Also Allenby made the acquaintance in these two years of many interesting types, British, Boer and native—administrators, adventurers, hunters, chiefs. Rhodes himself, accompanied the Bechuanaland expedition, one of the results of which was to secure the future Rhodesia for the British Empire.

After a tour of service at the Cavalry Depot at Canterbury, Allenby was appointed Adjutant of his regiment in 1889. A year later it returned to England and he finished his term under peace conditions. "He had not been previously regarded "by his brother officers," writes General Wavell, "as 'a keen soldier.' He was "popular with all ranks : had a strong sense of humour with just a touch of irony "in his good-natured comments. A great reader on all manner of subjects uncon" nected with his profession, he held original ideas on many matters, military and " civil, and did not hesitate to give expression to them, however contrary they may " have been to accepted standards. He was an acute judge of character, and when " he conceived a dislike, it was invariably found to be justified sooner or later. He " hated and despised to an exceptional degree anything in the least savouring of " sharp practice, immorality or of cowardice, moral or physical. He had a strong " scientific bent which expressed itself in various ways, but found its chief outlet " in love of natural history.

"When he became Adjutant his general outlook seemed to change and his air of "good-natured insouciance was replaced by a determined thoroughness. He soon "made the most carcless of subalterns understand that duty came before pleasure "and parade before leisure, and that there was a serious side to soldiering."

Another result of the experience he had gained as Adjutant was to make up his mind to stick to soldiering. Though still a bachelor and comfortably off he was not a rich man. He hated war, but perhaps he realised that it was inevitable—in South Africa. He was by nature far-sighted.

The next step in the carcer which he had now definitely adopted was obviously the Staff College—a somewhat unusual proceeding in those days, almost eccentric indeed, for a cavalry officer. At his second attempt he passed in successfully, the only cavalry officer to do so, or even to qualify. There one of his fellow-students was Captain Douglas Haig. When the time came to elect the Master of the Drag, Allenby was elected. Haig was undoubtedly the better rider, but Allenby was more popular with the students. Perhaps also it was thought that Allenby was likely to take more trouble with the pack and spend more time at the kennels. During his Mastership, Allenby won the Heavy-weight Point-to-Point, riding his own line he came in to beat Colin Mackenzie on the post.

Lord Allenby was married while at the Staff College.

On leaving he was almost immediately appointed Brigade-Major (or rather Adjutant, as the post was called in those days) of the 3rd Cavalry Brigade at The Curragh, of which his regiment formed part.

On the outbreak of the war in South Africa Allenby, who had rejoined his regiment, followed it with his squadron to Cape Town. His transport had broken down near the Cape Verde Islands and been within an ace of being driven ashore on one of the outlying islands. It is a tale too long to tell, but it was Allenby's knowledge of seamanship that saved the ship.

He rapidly made his name in command of his squadron in the Colesberg district under Sir John French. His previous experiences in South Africa and his knowledge of the ways of the Boers and of the natives was of the greatest value to him and whenever a difficult job had to be done he and his squadron were generally selected for it. He commanded his regiment for nearly a year in the Cavalry Division in the absence of the C.O. on sick leave, and it was a great disappointment that he was not confirmed in the command. " Mike " Rimington was senior to him in the regiment and was brought back from Rimington's "Tigers," the regiment which he had raised at De Aar on the outbreak of war (with the late Lieut.-Colonel H. R. Gale, R.E., as his Intelligence Officer). Both Rimington and Allenby were not long in being given command of independent Columns. In the autumn of 1901 a great deal of the success of General Bruce Hamilton's group of Columns in the Eastern Transvaal was undoubtedly due to Allenby's Column, although the credit was generally attributed to the fact that General Bruce Hamilton had the famous scout Colonel Wools-Sampson as his Chief Intelligence Officer. Allenby's Column was a fighting column, and General Wavell confirms the fact with more than one quotation from letters of officers who served with or under him. He took no unnecessary risks : he took every precaution never to be surprised : but "Safety First " was not to be found in his Dictionary of Military Terms!

General Wavell takes the opportunity to discuss at some length the characters

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of Allenby and Haig. He sums up as follows:—" Allenby was the more broad-"minded and the more human; Haig by virtue of concentration was the more "technically efficient. Haig was Scottish to the bone, Allenby was English to the "core. The two men never understood each other well, nor were they easy in each "other's company." It is recorded that when on a certain occasion during the Great War it had been arranged that they should meet and discuss an important matter, neither of them mentioned it. Allenby made up his mind never to see Haig except in the presence of a third person.

Allenby—A Study in Greatness is a book which will cagerly be read by everyone who knew him. It can be warmly recommended to every keen soldier with ambition to gain the bâton of a Field-Marshal.

There is an excellent index, good sketch maps and some interesting photographs.

H.B.B-W.

DYNAMIC DEFENCE.

By CAPTAIN B. H. LIDDELL HART.

(Faber and Faber, Ltd., 24, Russell Square, London. Price 28. 6d.)

In this booklet Captain Liddell Hart, after sketching the course of the war and deducing lessons therefrom, criticizes the higher direction of the Army prior to and during the war, and concludes with his ideas of a new war policy. Much of the contents are controversial, but with his main contention of the necessity for a highly mobile and hard-hitting army with young and vigorous commanders in control, most soldiers will be in entire agreement.

As regards the battle of France there is no doubt that the German armoured divisions played a dominating role in the overthrow of the French armies, and that General Gamelin incurred a heavy responsibility in not replacing immediately the divisions he moved into Belgium by troops from the Maginot Line. It is only fair, though, to add that General Gamelin was absolutely opposed to the weakening of his front by going to the relief of the Belgian Army.

The author admits that the new style combination of dive-bombers with fastmoving tanks has succeeded in penetrating modern defence only when and where the opponents were short of up-to-date counter-weapons (and also, I might add, stout hearts, *vide* the actions at Calais and Dunkerque) and relied on an out-of-date technique.

It is not therefore apparent why he criticizes the British General Staff for not forming more than two armoured divisions prior to the war, since it seems that only five (some authoritics give thirteen) out of the sixty-three German divisions employed in the invasion of France were armoured, the remainder being infantry divisions, some eight of which were motor-borne.

The British General Staff in their policy were well abreast of the German proportion before the war, taking into account the small number of our pre-war divisions, and that some of them had been converted into anti-aircraft defence units. That the money was not forthcoming for the armoured vehicles was the responsibility of the government in power, who had openly declared that they had disarmed to the edge of risk.

Undoubtedly the real reason for the downfall of France, as becomes more and more obvious from the accounts of eye-witnesses, was the lack of fighting spirit and of the will to win in the nation, coupled with the confusion and even chaos caused by Fifth Column activities.

Further in the booklet, the author takes the C.I.G.S. (General Sir A. Montgornery-Massingberd) to task for declaring in 1933 that "the Army was not likely to be "used for a big war in Europe for many years to come." The C.I.G.S. was but voicing the Government policy that no major war need be expected for ten years. When subsequently this period was reduced to a matter of months, the necessity for making up leeway at once does not seem to have been appreciated. Thus it was that the lack of funds and the desire not to standardize too early (as Goering did with his *Luftwaffe*) resulted in our armoured divisions not being ready when the flag fell.

The chapter on "A New War Policy" advocates the training of our Army in "soft spot" tactics, exploited to the utmost by armoured vehicles. It is quite sound, when you can find a soft spot. In the last war they were difficult to discover, and then could only be taken advantage of to a small extent. The idea, however, that we should limit our armies to men who are psychologically as well as physically fit, will not, I fancy, appeal to our generals, when they contemplate the extent of our commitments and the size of the opposing armed forces. One recommendation is made—" attacking the weakest point of the Axis—by overrunning Italy's African " Empire." Should this be carried out, there will be plenty of work for the R.E. in water supply.

In the appendix the author is quite entitled to take credit for his advocacy of armoured divisions in war, and quotes extracts from his articles on the subject. He must not be surprised, however, if his reviewer also quotes from a lecture delivered by Captain Liddell Hart at the R.U.S. Institution in January, 1931, in which he maintained that in the 1914–18 war, we should not have sent our armies to fight in France nor have introduced conscription, but we should have limited our effort to the blockade and to developing our industrial capacity for supplying and munitioning our Allies I

C.G.F.

AIR PHOTOGRAPHY APPLIED TO SURVEYING.

By C. A. HART.

(Longmans, 1940. Price 25s. net.)

This book, which opens with a Foreword by Sir Alexander Gibb, is by the Senior Lecturer in the Department of Engineering at University College, London. As Sir Alexander remarks, the book is written from the standpoint of the prospective user of the method, and is not specially addressed to experts. But the latter will also find the book of real value in giving a wide, and at the same time, exact, view of a subject which more and more engages the attention of explorers and surveyors of all kinds.

The headings of the various chapters will serve to give an idea of the scope of the work, thus: Historical Summary, Interpretation of Air Photographs, Practical Applications, Principles of Air Photography, Elementary Perspective, Stereoscopy, Radial-line Method, Contouring from Air Photographs, Preparation of Maps, Stereoscopic Instruments and Plotters, Small-scale Mapping. This range of discussions and examples covers a wide field. The reader will find the explanations clear and the book well illustrated. It could safely be put into the hands of anyone desirous of ascertaining the scope of the subject and its present position. It will serve admirably as a text-book and as an introduction to more detailed technical works and specialized studies. The book contains between its covers information which might otherwise have to be sought for amongst the hundred books which are referred to in the bibliography at the end.

It is pleasant to record the fact that the author gives full credit to various Royal Engineer officers for the part that they have taken in putting air-survey on a practical footing. Amongst those mentioned are R. L. Brown, D. R. Crone, M. Hotine, M. N. MacLeod, E. H. Thompson, and H. St. J. L. Winterbotham. With regard to Lieut.-Colonel Hotine, he remarks, "Those who wish to study thoroughly the scientific "basis of photo-grammetry cannot do better than read Hotine's book, Surveying "from Air Photographs. Major Hotine has probably done more than any other man "to put air survey on a sound and rational basis."

In the first chapter Dr. Hart mentions the effect on the output of the Ordnance Survey of drastic post-war economies, and states that "The Ordnance Survey, "after a long period of experimental work, has concluded that air-survey should "play an important part in the revision of large-scale plans." This statement is somewhat too definite and requires qualification. So far as the use of air-photographs is concerned, in the preparation of our national plans, the matter has not yet gone beyond the experimental stage. The Ordnance Survey Committee of a few years ago recommended that "the Government should consider the formation of a special "Air Survey Unit capable of satisfying the requirements of the Ordnance Survey." Up to the outbreak of the present war the matter was held in abeyance, and, of course, now it must be shelved until the war is over. No doubt something will then be done, but there are difficulties to be reckoned with, one of these being the weather. On only about thirty days in the year is the climate clear and bright enough, in this country, for good air photography.

In the necessarily compressed account of early balloon photography, beginning with the photographs of Laussedat, in France, in 1858, and continuing with Woodbury, in England, in 1881, mention might have been made of the experiments of Major Elsdale, R.E. in 1883-87. He used small captive balloons with considerable success, notably at Halifax, N.S. The method was also employed by Mr. P. L. O. Guy, in the excavations at Megiddo, in Palestine, in 1927 and subsequent years, and has still, at least for archaeological purposes, a certain usefulness.

The author thus classifies the main methods of air survey :---

- Graphical or semi-graphical methods of plotting from vertical photographs, for fairly large scales.
- (2) Plotting by elaborate machines for large scales.
- (3) Machine plotting for medium scales, with minimum ground control.
- (4) Small-scale surveys by oblique photography.

Now, here we arrive at the battle ground of machine plotting versus graphical, or semi-graphical plotting. The opponents of the use of elaborate plotting machines point out that each such machine, (of which there are very few examples in this country), constitutes a "bottle-neck." They also point out that, even with the use of these large and expensive machines, a certain amount of ground work is required for large scale surveys; for instance, fixed points are required, and names, boundaries and descriptions necessitate perambulation of the ground. On the other hand, those who pin their faith to plotting machines say that, broadly speaking, on medium scales, height fixing and contouring from air photographs really involve the use of elaborate machines, though makeshift graphical methods may, and sometimes must, serve for reconnaissance mapping in frontier regions.

Another aspect of the case is that there has, at times, been a tendency on the part of the more strenuous advocates of the use of plotting machines to deny the excellence of those typographical surveys in tropical countries which have been carried out by old, normal methods. Extravagant statements on both sides are to be deprecated. Air survey has its abundant uses, and there are cases in which air photographs may conveniently be translated into maps, by graphical means. There are other cases in which the use of machines is almost imperative. And, again, there are many cases in which the old, pedestrian, normal methods may properly be preferred. Thus, in 1929, Winterbotham remarked, " that in easy country a height control of " four points per overlap would cost almost as much as a complete one-inch map." The reader who studies this book will be able to judge for himself which solution of the problem is best applied to any particular scale and country.

There is an excellent chapter on the interpretation of air photographs. Stress is rightly laid on the great value of stereoscopy in this sometimes difficult task. Hotine is quoted as saying that " the study of a pair of aerial photographs, under a stereo" scope, gives the most detailed and complete view of the earth's surface yet obtained " by man."

The value of the additional information given in a photograph, as compared with that obtainable from a plan, is emphasized by the statement that "It has become "commonplace to produce a mosaic as well as a line map for (engineering) surveys "on medium and large scales."... "In Canada at least twenty uses have been "found for photographs other than those for which they were taken."

As to scales,—for large scales of from 1:1,000 to 1:5,000, especially for engineering surveys, photographs have proved of great use. But, in these cases, ground levelling must be carried out in addition. For medium scales of 1:5,000 to 1:30,000, much experimental work has been carried out, and the Arundel method of graphical plotting is accepted by British official authorities, though there are difficulties where the ground heights vary considerably. For small scales of 1:30,000 to 1:250,000, India has become an important field of experience. In the frontier regions much use has been made of obliques, and Major D. R. Crone, R.E. has devised a successful way of determining heights from obliques.

But, in the British Empire generally, it is Canada which has led the way in the application of photography to surveying, ever since the time of Deville in 1888. And, as regards recent years, it is sufficient to remark that, according to the author, between the years 1923 and 1933, oblique photographs were taken of 277,000 square miles, and vertical photographs of 125,000 square miles. The obliques have been of great importance in extending our geographical knowledge of the northern regions of the great Dominion.

As to official policy in this country, Dr. Hart says that, "largely on the initiative " of the Air Survey Committee, it has been the object to produce, as a matter of " routine, approximately vertical photographs so that simple graphical plotting is " adequate for many purposes." On the Continent greater trust in the use of expensive and elaborate plotting machines has been the general rule. This is the position as regards the conversion of air photographs into maps. As to the taking of the photographs themselves, in Great Britain, reliance has hitherto been placed on the readiness of private firms to co-operate, though, as previously mentioned, a hint was thrown out by the Davidson Committee that a special, official air-survey unit might eventually be formed.

In the chapter on perspective the author states that "much of the pioneer work "in applying perspective theorems to the solution of problems of air survey has been "due to Hotine." In this chapter the mysteries of isocentres, isometric parallels, principal points, tilt distortions and height distortions, are clearly dealt with. The most elementary problem is, of course, the scale of the photograph resulting from a vertical exposure, at a given height, over a plane surface. If, for instance, we take a camera of focal length of seven inches, at a height above ground of 15,000 feet, the resulting scale will be slightly smaller than 1 = 25,000, which is a useful military scale. In the same chapter there is a discussion of the errors caused by the assumption that height and tilt distortions are radial from the principal point, and much else of importance.

Stereoscopy plays such an important part in the practical employment of air photographs that anyone interested in the subject will be sure to study what is here said about it, for the success of air survey methods is largely bound up with the use of stereoscopy. The author remarks that practice in stereoscopic observation is essential for good work. The theory of stereoscopic vision and the use made of it in air survey, require a good deal of attention and concentration. One is almost tempted to say that nothing stereoscopic is easy.

A brief reference to the Arundel Method may be permitted. This is described with some fullness in a chapter devoted to this and other forms of the radial line method. Its great merit is simplicity. The principal point of each photograph, which is normally the plate centre, " may be taken as the instrument station for the measure"ment of angles to all points on the photograph," and the principle is the same as that of intersections on a plane table. The photographs are taken in strips, with a longitudinal overlap of 60 per cent, and, if possible, a lateral overlap of 30 per cent. The base lines are drawn on each photograph "through the images of principal points of adjacent photographs," and it is here that the use of a precision stereoscope becomes valuable. The whole method is well explained. All this needs the most careful attention to detail, and demands good, equal, eyesight and considerable practice. "According to the results obtained by the Air Survey Committee . . . a plan to a scale of I : 25,000 can be made as accurately as any ground survey, with ground control provided by a triangulation with sides averaging 10 to 12 miles in length."

As to contouring by non-machine methods, one may say that it can be done with some measure of success, but with no great accuracy. It is stated that adequately exact contoured maps can be obtained by the Arundel method, plus simple stereomeasurements, for a scale of 1:15,000 and smaller scales, provided that there are sufficient spot levels on each photograph. Dr. Hart sums up this particular matter thus: "The British policy of concentrating on simple methods has led to a con-"siderable measure of success in planimetry, but contouring has proved much more "difficult."

Fifty pages of the book are devoted to a description of stereoscopic instruments and plotters. It may be predicted that when this war is over, elaborate plotting instruments will come more generally into use in this country. We already have some of these plotters of foreign make, but we may hope that, when the demand arises, British firms will be encouraged to meet it. Most of us will agree with the author who suggests the establishment in Britain, or the Empire, of some institute where plotting machines could be made available for general use. And there we may leave the question.

C. F. ARDEN-CLOSE.

THE ROAD AND RAIL TRANSPORT PROBLEM.

By BRIG.-GENERAL SIR H. OSBORNE MANCE, K.B.E., C.B., C.M.G., D.S.O., M.INST.T. (Sir Isaac Pitman and Sons, Ltd. Price 78, 6d. net.)

The above-named book is a masterly review of the very complicated problem of rail and road transport from the point of view of determining what system could be made possible so as to enable each to function without interfering unduly with the other. The book should prove most useful to the expert in transport problems. From the very complicated nature of the problem as set forth in the treatise it appears to be somewhat beyond the grasp of the general reader.

It might have made the book clearer if some graphic diagrams had been added showing in a simple manner the rates charged in the various schedules quoted in the book, showing on the credit side the actual rates charged and on the debit side the actual cost of transportation, fixed charges, interest on capital, etc., so as to show how the rates have been arrived at. This information is not easy to assess from the text.

From a study of the treatise the reader gains a very fair idea how motor transport competes with the railways and how the latter are handicapped by the high Rates they have to pay compared with their competitors.

The present war may quite possibly profoundly modify the whole system of transport generally and a second edition to bring transport problems up to date and how best to deal with them would prove an invaluable guide to the authorities dealing with the whole question after the war is over.

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REVUE MILITAIRE SUISSE.

 $(May-June, 1940.) \rightarrow \hat{A}$ propos de la défensive. By Colonel Montfort. A modern defensive position has to be framed principally with a view to anti-tank defence. Every strong point in it must be provided, naturally or artificially, with anti-tank obstacles. This is the doctrine which the author has endeavoured to instil for some years. More than ever, since the German campaign in Poland, and the break-through at Sedan, must the defence in depth take measures against tanks, both medium and large. Furthermore, measures to defeat the dive-bomber must also be included.

Colonel Montfort urges a strengthening of the Swiss defences.

La défense Anti-chars. By Lieut.-Colonel Perret. An appropriate article to follow the preceding one. Nothing is more important to-day, for a small nation surrounded by menacing neighbours, than to look to its defences against mechanized armies.

Anti-tank defence comprises the construction of obstacles, (passive defence) and the provision of anti-tank weapons (active defence). The author considers the most effective barriers are a combination of reinforced concrete stumps and triangular ditches, faced with masonry or concrete. Such barriers should be in three successive lines at least, about one kilometre apart, with their flanks resting on deep rivers, lakes or forests. The active defence calls for a more liberal endowment of anti-tank guns. A Swiss division disposes of thirty 47-mm. guns, while a German division before the war had eighty-five. But whence will come the additional trained gunners? The author suggests a reduction of the present gun-crews from seven to five. He also advocates the appointment of an anti-tank officer to each infantry regiment and to each divisional staff; the doubling of the number of 47-mm. guns in a division; the addition of a company of anti-tank guns to a regiment; and the arming of each company and battery with two anti-tank rifles apiece.

Honneur et Fidélité. By G. de Reynold. A review of a new edition of a book with this title, by Colonel Paul de Vallière, first published in 1913, and covering the military history of the Swiss in foreign service.

Les forces armées de l'Italie. By Major Farrod. A few short notes on the Italian Army, as reinforced and re-equipped under Mussolini. Military service is obligatory between the ages of 21 and 55; national service, between 14 and 70. The land forces comprise 18 Army Corps (about 55 infantry divisions), 5 to 7 mountain divisions, 2 motorized (livisions, 3 light divisions and 3 armoured divisions. It is probable that the proportion of mechanized divisions has been considerably altered.

Italy's oversea possessions have necessitated a considerable dispersal of troops and the formation of Colonial armies of different value.

Commentaires sur la guerre actuelle. The invasion of Belgium, Holland and France had begun when this commentary was written. The Germans used new methods aerial invasion, parachute troops, fifth columns—but to those who had studied pre-war German military literature, there should have been no surprise. The Germans threw aside pre-conceptions. The real surprise was in the violence and suddenness of their attacks rather than the novelty of their methods. The campaign in Norway interests the Swiss, for the country bears many analogies with their own. The use which the Germans made of their armoured vehicles in the mountains of Norway is noted by the Swiss commentator.

The allied operations emphasized two factors :--troops without heavy armament have no offensive power, and aviation is powerless without a strong ground organization. In the invasion of Holland, the parachute contingents were on a large scale, and carried a considerable armament. The men were highly trained and knew exactly what to do when they landed. They were released in groups of eight from a height varying from 250 to 100 metres, and usually at dawn. They had no difficulty in regrouping themselves on landing. They first made for bridges and aerodromes. At Waalbofen, Rotterdam, 800 men are said to have landed in half an hour, with all their equipment, and even bicycles and motor cycles. These advanced guards spread terror and stupor among the defenders, and the tanks, following swiftly, completed the breakdown of organized resistance.

The vulnerable part of a tank is its roof; hence bombardment of a tank column from the air is an effective form of attack. Even a small bomb exploding on the tank is sufficient to put its crew *hors de combat*.

The hampering of the troops by the masses of fugitives on the roads is remarked, and unless the evacuations can be regulated in good time, it is much better for the civil population to stay where they are.

(July, 1940.)—Quelques données sur l'Armée Allemande. By Captain X. Some reflections on the causes of the outstanding successes of the Germans during the present war.

The German soldier is taught the superiority of attack over defence. In spite of the disarmament of Germany by the Treaty of Versailles, in a few years the German will to win made it possible for Hitler to build up a vast new armament. It is true that the impulse to serve is largely based on fear of the consequences of indifference, but the result is a mighty weapon.

German strategy is not mysterious, nor does it break away from the time-honoured rules, but it is applied with uncommon success at the selected place and the selected moment. While the lightning attack on Poland was being made, the French were kept off by the western lines. Some 60 or 70 divisions were hurled against Poland, and only 40 held the western front at first. Victory at the decisive point can only be won by stripping the secondary fronts.

In tactics, too, the Germans know how to stand on the defensive while seeking a decision elsewhere by all available forces.

France trusted blindly in the solidity of her Maginot Line, but she did not carry the line to the sea with the same strength. She clung to her belief in the methods of the past, while Germany forged new and up-to-date weapons of attack. The German commanders were made responsible for every stage of administration, and there were no politicians to interfere.

Recognizing the vital importance of air superiority, the Germans set out to ensure that they got it. They were able to adopt the latest types, and to embody the lessons they had learned in Spain. By the middle of May, 1940, says the author, Germany had at least 12,000 first-line planes.

The "infantry of the air " and the parachute troops formed a force of the greatest importance. There were several regiments of these parachutists, who formed the spear-head of the invasion of Holland. But fortune favoured the employment of these troops. There was little or no opposition on the ground. Germany now has several divisions of these troops; and they were expected to play a big role in an invasion of England.

The motorized divisions were multiplied, as were also the tank divisions. The Germans have committed themselves to an enormous consumption of petrol, and if their armies become heavily engaged at the same time as their great *Lüftwaffe*, it is not beyond the bounds of possibility that their petrol supplies will fail to keep pace with consumption.

The armament of the infantry has been powerfully increased. Each German infantry regiment has 2 heavy guns, 6 light guns, 18 light and 27 heavy trench mortars—all weapons of offence. It also has 12 anti-tank guns and 27 anti-tank rifles.

The Pioneers are combatant troops, and are more akin to our Field Companies than our conception of pioneers.

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The tactical superiority of the Germans over all their continental opponents so far has been shown by their rapid overwhelming of the front-line troops by heaviness of artillery fire and dive-bombing. Only the stoutest troops can stand up to the avalanche of fire and noise which falls on them. Poles, Dutch, Belgians and French have all been defeated by lightning attacks, carefully prepared and launched with a maximum of power behind them. The tank divisions carried all before them, and were on the shaken troops before they could recover from the air bombardments. La guerre brusquée descended on a France lulled into a false sense of security behind the Maginot line, and—as it is now clear—weakened by a decadent political control.

Honneur et Fidélité. The editor adds a further review of Colonel de Vallière's history of Swiss troops in foreign service. As mercenaries, they carried their standards all over Europe, and have given some famous names to military history.

Commentaires sur la guerre actuelle. This month's commentary confines itself to the reflection that it would be impossible for Switzerland to undertake a modern offensive, even on a small front. It has not the means. Its infantry must be trained to a guerrilla warfare.

(August, 1940.)—Milice. By Major de V. A reply to an article in the preceding number, entitled "Reflections of an Infantry Officer" (not reviewed). The author points out that the term militia properly applies to all non-professional armies, even to those like the French, filled up by large numbers of reservists. The Swiss Army, however, pays much more attention to training its soldiers under officers and N.C.O's who already know them ; the young men from the same districts are called up to serve together, and return to civil life together. Compared with the French, the Swiss call up ten times as great a proportion of their annual classes. The French unit of instruction is the regiment; in the Swiss Army, it is the division. The Swiss soldier is a "soldier at home "; the French soldier goes back to civil life and drops his connection with the army until he is called to the colours again, either for war or for rare and exceptional causes. When mobilized, the Swiss Army is composed of men uniformly trained and of uniform quality; the French Army has half a million regular soldiers swamped among 5 or 6 millions of reservists and Territorials, whose training is considerably inferior to that of the Swiss.

Le Canal de Suez. By Ro. An article of topical interest, giving a brief account of the origins of the Canal. The relationship between England and Egypt, as modified by the agreements made since the last Great War, is referred to in the concluding paragraphs. Italy's claim to a larger voice in the administration of the Canal, since her conquest of Abyssinia, lends interest to the position in which she now finds herself owing to her partnership in the Axis.

The British defence of the Canal against the Turks in 1914-16, which is barely mentioned, did not call upon the Egyptians for a single soldier.

Organisation fonctionelle de la défense anti-aérienne. By Dr. D. A short article on A.R.P. organization. The Swiss have not yet been obliged to develop this service beyond elementary stages.

Commentaires sur la guerre actuelle. This month's commentary is restricted to some remarks on defence by anti-aircraft gun. Referring to the almost instantaneous destruction of the Polish air force, before it had scarcely left its aerodromes, the author remarks "we see in the Polish war more of the Polish defeat than of the German victory."

Our efforts in Norway were rapidly dispersed by the superior German air force, because we did not have a sufficient number of A.A. guns.

The chief point to be noted from the article is the approval of the 75-mm. gun as an A.A. weapon, an opinion which was not, apparently, shared by the Finns, who preferred a much larger calibre.

W.H.K.

THE MILITARY ENGINEER.

(September-October, 1940).-Engineers in the Third Army Manauvres.

Colonel W. A. Johnson describes the work carried out by the Engineers in the Third Army manœuvres, held in the Sabine area in Louisiana in May, 1940. The area in question is the best manœuvre area the American army has had in time of peace, and it afforded excellent practice for Engineers, amongst whom nearly every Engineer unit in the United States army was represented.

During the planning period, the duties of the Engineers were, amongst others, to provide and distribute the necessary maps, and to reconnoitre the manœuvre area in order to perfect plans for the supply of water and engineer materials and equipment.

During the actual manœuvres the Engineers were mainly employed on the supply and purification of water and on bridging. Besides constructing a number of pontoon bridges, they used about 300,000 square feet of planking in repairing or rebuilding some 400 bridges and culverts. The new engineer equipment was severely tested, and needed improvements were brought to light.

Engineers in the Van. Comments on the Third Army Mancouvres. By Colonel S.C. Godfrey.

This article covers some of the same ground as the previous one. In the manœuvres described, mobility was the objective, and in the process of aiming at that object lessons were learnt that will be of inestimable value in future training. An increase of engineer strength is advocated, *i.e.*, the addition of a fourth company to the battalion of divisional engineers. The need of two Engineer regiments with an army corps is now established.

Aeronautical Charts. By P. A. Smith.

The task of providing aeronautical charts for the whole of the U.S.A. was assigned to the Coast and Geodetic Survey in 1926, with directions "to provide as adequate charts for air navigation as it now provides for ocean navigation." Strip charts, originally thought most desirable, were found to be quite inadequate. Sectional charts, on a scale of t in 500,000 were prepared, but a reduced scale was found to be more satisfactory. It is hoped to complete a set of 17 regional charts on a scale of t in 1,000,000 by 1941.

The River and Harbour Functions of the Corps of Engineers.

Brig.-General T. M. Robins defines some of the functions of the Corps of Engineers in connection with rivers and other waterways. The current procedure followed in the development of river and harbour improvements has been evolved during the past hundred years.

Varions functions entrusted to bodies consisting partly of the Corps of Engineers and partly of Civil Engineers have been: the Mississippi River Commission, the California Debris Commission, Flood Control, the Lakes' Survey, Hydro-electric Power Development, Irrigation, etc.

The Highest Standard-Gauge Railway in the World. By T. G. Murdock.

A description of the Central Railway of Peru, a line 215 miles long, running from Callao, via Lima, across the Andes, to Huancayo. The highest station is Ticlio, at an elevation of 15,610 feet. The gradients are not as steep as those on the Transandine railway between Chili and Argentina, where rack locomotives are used. The average gradient from Callao to Ticlio is $2\cdot77\%$ and for the last half of the distance it is $3\cdot41\%$. There are twenty-one zigzags on the entire system. The line was completed in 1908, but a certain amount of reconstruction has taken place since.

Motor Movement on Manauvres. By Captain H. W. Pote.

A report on the movement of a convoy of 34 motor vehicles, covering a distance of 325 miles in two days. The use of motor cycles was found to be an ideal means of co-ordinating action while under way.

Leading Articles. (1) Plenty versus Scarcity: showing the importance of laying in stocks of food, raw materials and manufactured products in peace time, both for normal and defence needs. (2) Melting Pot. A record of past immigration into the United States, showing that a more careful selection should be made of future immigrants. (3) A Tough Job for Germany. A hint at the difficulties that Germany is likely to meet in warding off famine and suppressing revolution in the nations she has conquered.

Meteorology in Peace and War. By Captain R. J. Martin.

In peace time meteorology is of great value in many ways, such as forecasting floods, storms that may damage crops, frosts, etc. In war time the weather has often had decisive effects on campaigns and battles. But little attention was paid to meteorology until the World War, and its value in future wars is likely to be greater than ever.

An Individual Camouflage Kit.

Captain Rodyenko gives a list of a portable outfit to be issued to troops, especially to Engineers, for camouflage purposes. The most important items are perhaps a machete and sketching materials.

The Coast Guard. By Rear-Admiral R. R. Waesche.

The Coast Guard is the Federal marine police agency of the United States. In peace time it has powers relating to customs and prevention of smuggling, navigation and merchant shipping, immigration, quarantine, protection of fisheries, etc. In war time it has more varied duties. Prospective officers of the service are trained for four years as cadets at the Academy in New London, Connecticut. The personnel strength of all ranks of the Coast Guard at the present time is about 18,000.

Achievements in Substratosphere Flying. By V. A. Ivanoff.

The problem of substratosphere flying has been studied for many years, and its difficulties are now practically solved. With a suitable apparatus and system successfully developed for supercharging of engines and aeroplane cabins, the efforts of designers and research engineers have culminated finally in a marked achievement.

The outcome is the 307-B Stratoliner, constructed by the Boeing Aircraft Company of Seattle, Washington. This is a ship weighing 45,000 lb., carrying 33 passengers, which, cruising at altitudes of 20,000 to 25,000 feet, has a normal cruising speed of 247 m.p.h., and a top speed of 300 m.p.h., with four engines of 1,250 h.p. each.

Pan-American Airways are purchasing three of these ships for operation from the United States to Rio de Janeiro.

Mention is also made of two new types of bombers: the B-19, an Army bomber, weighing 70 tons gross, and having a range of 6,000 miles, and a giant Navy bomber, weighing 84 tons, which is expected to have a range of 12,000 miles.

A two-engined Grumman pursuit plane, built for the U. S. Navy—the Skyrocket —has been released for export. With two 1,200 h.p. Wright engines, its speed has been estimated at 450 m.p.h.

A new Motor-Cycle Machine-Gun Car.

Colonel H. W. Eldred has produced detailed sketches of a proposed motorized machine-gun, for which he claims many advantages.

Equipment for Engineer Troops. By Brig.-General J. J. Kingman.

This article consists of six pages of photographs showing some of the latest types of engineer equipment in use in the United States Army. The equipment illustrated consists of the following: River Crossing Equipment (Assault boats, foot-bridge, light pontoon bridge, steel portable bridge), Construction, Electric Lighting, Water Supply, Map Reproduction and Experimental Equipment.

A. S. H.

BULLETIN OF THE SOCIETY OF AMERICAN MILITARY ENGINEERS.

(October, 1940.)—The Swiss System of Compulsory Military Service. By Paul Baumann.

The writer, a native of Switzerland and a former soldier in her militia army, describes the system of military service in vogue in that country and its effect on the cultural, economic and social life of the nation. The system was established in 1668 in the same form, substantially, as it exists to-day.

Mr. Baumann sees no reason why a similar form of compulsory service should not prove beneficial to the United States of America.

Mobility and the Engineer. By Colonel S. C. Godfrey.

The problem of the modern army is to take advantage of the increased speed given to it by mechanization and aviation. The writer shows how the problem affects Engineers, both in attack and defence. Still more significant, perhaps, with regard to mobility, is the task for the mechanized engineers with armoured divisions, and for the newly-constituted aviation engineers who will serve with the G.H.Q. Air Force.

Research in the Military Sciences.

Major W. Bowie lays stress on the desirability that leaders of the military forces should keep in continuous touch with the staffs of private research laboratories.

The Automotive Diesel Engine.

Mr. O. D. Treiber, of the Hercules Motors Corporation, points out the advantages to be gained by the general use of the Diesel engine over the petrol engine in military vehicles.

The cost of fuel is far less than that of petrol, though this is an advantage that appeals more to users in European countries, where petrol is expensive, than to those in America, where it is cheap.

Other points in favour of the Diesel engine are: -(1) the lower flash-point of the fuel, thus ensuring greater safety against fire, (2) the absence of electrical ignition, (3) a wide range of fuels, (4) absence of carbon monoxide in the exhaust, (5) less gearchanging. The Diesel engine could eventually replace all petrol engines in military vehicles.

Let's have a Look at the Initial Protective Force. By Captain B. D. Gill.

In the event of war the Initial Protective Force of the United States is to consist of the Regular Army and the National Guard. Both will require large additions to bring them up to strength on the outbreak of war. The Navy will have quite enough to do to guard two long coasts.

The writer suggests that the Regular Army should be kept up to war strength in peace-time, and that the National Guard should act as a reserve line for the Regular Army on the outbreak of war.

Air Port Drainage is Important. By Brig.-General W. A. Mason.

The usual method of draining an air port is by means of surface drains alongside the paved runways. These drains must necessarily be long, and their great length involves the adoption of flat gradients. Ordinarily the run-off is collected by providing continuous interception in the drain lines. The drain trenches are filled with crushed rock or gravel, and this filling material passes the water direct to the drainpipes and thence to the outlets.

An alternative plan for interception of surface water is to provide inlets fitted with gratings at frequent intervals along the sides of the runways. This plan has some obvious disadvantages.

In laying drains the main troubles to be guarded against are breakage and disalignment. Flexible metal drain-pipes, perforated at points where water is to be collected, have been found to give good results. They are practically immune from breakage, even under covers as light as 12 to 18 in.

Rapid Concretion at Low Cost.

Lieut.-Colonel S. B. Moore describes the execution of a building project at

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Galveston, Texas, in which reinforced-concrete structures were built for less than similar structures in wood would have cost. The buildings were of a uniform pattern and it was necessary that they should be proof against floods, hurricanes, and white ants.

Standard forms, rectangular in section, were used for the columns and floor or roof beams. The latter—pre-cast—were raised and set in place equidistantly as if they were wooden joists. The beams, when in the moulds, had holes made through them near the neutral axis. Before raising into place, short pieces of $\frac{1}{2}$ -in, round bars were inserted in these holes, and then 2 in. by 4 in. wooden pieces with holes to match were attached to each side of the concrete beam. These wooden pieces were hoisted into place at the same time as the main beam. Wooden floor sections of standard size were dropped into place, and the concrete floor was ready to be poured as soon as the conventional slab reinforcement had been placed. In order to remove the forms it is only necessary to take out the short lengths of $\frac{1}{2}$ -in, steel.

A.S.H.

RIVISTA DI ARTIGLIERIA E GENIO.

(April, 1940.)-Forzamento dei corsi d'acqua.

Lieut.-Colonel Morera deals with the forcing of a passage across watercourses under the heads of (1) reconnaissance, (2) organization and (3) execution of the passage.

Under (1) come aerial and ground reconnaissance and the various points on which information is required.

Organization covers a large number of points, the most important being the materials available, their collection and transport. In forcing a passage across a river that is strongly held, a reserve of 150 per cent to 200 per cent in material and of 50 per cent in personnel should be provided. All bridging material should be assembled at a selected spot near the river bank on the night previous to the attack.

The execution of the passage is subdivided into (a) preliminary operations, (b) erection of bridges, (c) passage of troops, (d) additional dispositions. The time required for constructing a bridge for 5-ton loads across a river with a velocity of 1-50 metres (5 ft.) per second can be worked out as follows: 25 to 30 minutes for the trestles, and 2 to $2\frac{1}{2}$ minutes per metre for the rest of the bridge. This is, of course, exclusive of the ramps and approaches. The troops should cross as soon as the bridge is completed, and arrangements should be made for keeping the bridge in repair, or, if circumstances reader its maintenance impossible, for removing it to a safer site.

Essicamento negli strumenti ottici, By Licut. Musco.

The efficiency of an optical instrument depends upon (1) its design and manufacture, (2) its condition owing to external influences during use. The writer deals with the second factor.

Changes of temperature cause condensation of moisture in the atmosphere, and the result is a film over the lenses which may interfere with accurate observation. The trouble is aggravated when the vapour includes oily particles derived from the hubricating oil used.

A description is given of the processes adopted for removing excess moisture by means of dehydrating substances such as phosphoric anhydride, chloride of lime and silica jelly. The latter has been found to give the best results.

Il servizio ad interruzione nel servizio radio-campale. By Captain Puglisi.

In the simplex system of radio-telegraphy, and with skilled personnel, an average rate of transmission of 60 characters per minute can seldom be exceeded. This speed is often reduced by requests for repetition and is aggravated by atmospherics.

The writer explains the advantages and disadvantages of the duplex and semiduplex systems.

THE INDIAN FORESTER.

(July, 1040.)—Forest Development in the United Provinces comments among other things on the deleterious effects of using cowdung as fuel, instead of allowing it to manure the soil. The consumption is said to amount to several millions of tons a year.

Many engineers come across cases where erosion of the soil causes damage to roads and other property through the formation of steep-sided nullahs, which work back until costly remedial measures are necessary. Early treatment is, of course, advisable, and methods of effecting it are given in Soil Conservation by Terracing and Grading.

A review of *Elementary Forest Mensuration*, by M. R. K. Jerram, M.C., shows it to be a useful book to anyone having to deal with standing or felled timber.

The report of the Principal, Indian Forest College, refers to a course for forestry students in practical field engineering at Roorkee, run by the Commandant and officers of the Training Battalion of the King George V's Own Bengal Sappers and Miners.

(August, 1940.)—Road Bridge Decking, by J. L. Harrison, begins with the sentence, "Covered wooden bridges are never seen in England or India." Nevertheless, up to a few years ago, many important road bridges on the Grand Trunk road in the Punjab were of timber, with waterbound macadam as surfacing, and there may be some of that type still. The author recommends the adoption of American types of bridge, where the decking is of r.i.f. concrete, and the rest of the bridge of timber, or else of all-wood bridges with a layer of asphalte between the decking and wearing surfaces, and fillets of asphalte cement inside the wheel-guards.

Other articles of interest are Notes on Terracing for Soil Conservation and Forestry in Britain. The present war has, of course, interrupted the Forestry Commissions' plan for reafforestation of the country, begun in 1919.

(September, 1940.)—The irrigation of formerly desert areas in the Punjab has had a disastrous effect in some areas, as salts have leached up into the soil, and rendered it practically sterile. Remedial measures are under trial, one of which is explained in The Experimental Afforestation of Water-logged areas in the Punjab. A variety of Eucalyptus was planted seven years ago, and already some of the plants have grown to 37 feet in height, with diameter at breast height of 3.8 inches.

Editorial notes comment on the livestock problem in India, and how it is complicated by the deification of the cow by Hindus. When a bull or cow reaches the age for retirement, it must not, in Hindu districts, be slaughtered, and so for the rest of its life it eats fodder, which could of course be more usefully employed. The effect is described thus "Poor pasture \rightarrow Low cattle efficiency \rightarrow Larger number to make good for the decreased efficiency \rightarrow Poorer pastures—and so on, *ad infinitum*."

F.C.M.

ERRATA.

June, 1940, R.E. Journal:—On page 154, in the Sub-heading read "Sudan Defence Force."

September, 1940, R.E. Journal:—On page 422, Lieut.-Colonel Sir H. Arthur Yorke and Lieut.-Colonel P. G. Von Donop should each be shown as a former Chief Inspecting General of Railways.

ANTI-SCATTER TREATMENTS FOR WINDOW GLASS. NOTES FROM THE INFORMATION BUREAU OF THE BUILDING RESEARCH STATION.*

VARIOUS methods which can be adopted to provide protection from flying glass from windows broken by blast have been described in publications; of the Ministry of Home Security; they include such measures as the provision of various forms of screens and shutters, the fixing of wire mesh and, finally, the application of adhesive treatments to the glass itself. It is with the last-named that this note is concerned. Tests of such materials are undertaken for the manufacturers at the Building Research Station and arrangements have recently been made whereby a list of those of them that have been tested and approved as affording a useful measure of protection by limiting or preventing the scattering of the glass fragments will be kept at the Station and at the Research and Experiments Branch of the Ministry of Home Security. Firms having a material which is included in the approved list will be authorized so to describe it in their advertisements.

In view of the number of enquiries that are being received regarding such treatments, and notwithstanding that it is not the general practice in Government publications to mention proprietary materials, by name, it has been considered useful in present circumstances to publish the present note which discusses the various types of adhesive treatments and includes a list of materials that are at present (19.9.1940) on the approved list. The list is subject to alterations by additions and, maybe, subtractions, but the arrangement whereby firms having materials on the approved list can advertise them as such will serve as a means for keeping it up to date. Further, the practical recommendations included in the note are given in the light of information at present available and may be subject to some modification, though practical experience gained so far has served to confirm that they are well founded.

It should be realized that no treatment applied to the glass will prevent its being broken, nor will even increase its chance of remaining unbroken when a bomb explodes nearby. Moreover, an approved material will not give good results unless it is properly applied, i.e., applied in accordance with the recommendations made in this note.

The present note mentions four different types of treatment. It is not intended to suggest that all four types afford an equal measure of protection but tests have shown that all the materials named, if properly applied, are useful. The choice of a particular type of treatment for a particular job must be left to the user, since it will depend upon various considerations such as the size of the panes, the importance of the windows to be protected, cost, etc. Moreover, supplies of any one type of material may not always be immediately available and possible alternatives may have to be considered. General Note on Application.

Before any treatment is applied it is important that the glass should be clean and free from oil or grease. When using any proprietary article, attention should be paid to the manufacturers' instructions for its use.

1.—TENTILE MATERIALS.

According to tests, almost any strong textile netting, such as curtain net, or similar fabric, can provide good " anti-scatter " protection if it is stuck firmly to the glass.

Nettings can be obtained for the purpose either plain or ready-treated with adhesive. With the latter type, there are various methods which different manufacturers recommend to get the best results from their own materials, e.g. :-

- (i) Dip the netting in water for one or two seconds only, then shake out the excess water and apply the net to the glass.
- (ii) Moisten the netting by spreading it on a wet cloth.

^{*} Crown Copyright Reserved. \dagger E.g., "A.R.P. Memorandum No. 12—The Protection of Windows in Com-mercial and Industrial Buildings," "Your Home as an Air Raid Shelter."

(iii) Wet the glass, and then apply the dry netting, patting it into place with a wet cloth.

The material should be cut large enough to allow for shrinkage and to permit of it being carried over the frames and stuck to them as well as the glass.

Plain ungummed netting can be affixed with any convenient strong adhesive, e.g., cold-water paste, flour paste or gum. The adhesive is brushed freely on the glass and the netting pressed on. If the window is one which is exposed to hot sunshine the addition of a little glycerine (say 5 per cent) to the adhesive will help to prevent it from drying out completely and becoming brittle.

In whatever way the netting is fixed, *i.e.*, whether it is of the ready-gummed type or a plain material applied with paste or gum, its adhesion will certainly be affected sooner or later if the netting is repeatedly exposed to damp conditions; if, therefore, the window is one which opens or if it is often subject to condensation, the netting should be protected with a coat of varnish, and in fact it is a useful precaution always to varnish round the edges at least, or secure them with adhesive tape to prevent them coming unstuck.

While fixing, it is often convenient to hold the top of the netting in position by drawing pins or (in the case of steel frame windows) with adhesive tape.

Although netting applied in either of these ways will generally be quite effective in preventing glass flying, the treatment will not necessarily be strong enough to hold up large panes of heavy glass and keep the fragments in place after the window is broken. A stronger and also a more waterproof job can be made by bedding the netting in a good elastic varnish; a full coat of varnish is brushed on the glass, allowed to get tacky and the netting applied. Finally a further coat of varnish is applied over the whole area.

As the number of nettings which has been tested is large, the list of those at present approved is given in an appendix to this note.

2.—TRANSPARENT FILMS.

A good degree of protection can also be obtained by applying transparent film, of which there are many different makes. Those tested have been of two types, namely Cellulose film and Cellulose Acetate film. A. (a) Cellulose Film.

The following materials have been approved :---

(1) " Celilynd."

British Celilynd, Ltd., Burwell Works, Lea Bridge, Leyton, E. ro. (In this case the film was reinforced with light textile netting.)

- (2) " Cellophane."
 - British Cellophane, I.td., 17–19, Stratford Place, W.1.
- (3) " Diophane."
 - Transparent Paper Co., Bury, Lancs,
- (4) " Rayophane."
 - British Rayophane, Ltd., Wigton, Cumberland,
- (5) " Sidac."

British Sidac, Ltd., St. Helens, Lancs.

To be effective, the thickness of the cellulose film should be equivalent to a "substance" of not less than 60 grammes per square metre.

In applying cellulose film it is important that the adhesive should be flexible, *i.e.*, one which does not become brittle on drying. Ordinary liquid gum can be used if glycerine or treacle is added in the proportion of about i teaspoonful to 2 tablespoonfuls of gum, or alternatively, an adhesive can be made from gum arabic and glycerine, as follows :—

Crush the lumps of gum arabic to a powder. Into 11 pints of hot water sprinkle 1 lb. of the powdered gum, stirring continuously. Keep the mixture hot (in a double saucepan) till all the gum is dissolved, stirring from time to time. Then cool and stir in 7 oz. of glycerine. If glycerine should be unobtainable, treacle may be used instead.

The adhesive should be brushed on the glass and the dry film applied with a roller, preferably in strips, say 4 in. wide, and placed side by side. The

×i.

film should on no account be wetted or dipped in water before it is applied since this weakens the film and is likely to make it ineffective.

(b) Self-adhesive Cellulose Film, i.e., film ready-coated with a tacky adhesive; this type of material is usually supplied in rolls of widths varying from τ in, to 4 in.

The following materials have been approved :---

(I) " A.R.P. Window Tape."

British Cellophane, I.td., 17–19, Stratford Place, W.1.

(2) " Cerrux."

Cellon, Ltd., Kingston-on-Thames.

(In this case the self-adhesive film is supplied together with a varnish; the two together constituting the "Cerrux Process.") (3) "Durez."

- Durex Abrasives, Ltd., Arden Road, Adderley Park, Birmingham, S. (4) "Sellotape."
- " Adhesive Tapes, Ltd., Brunel Road, Old Oak Common Lane, Acton, W.3.
- (5) " Transotape."

Messrs. John Gosheron & Co., 1-6, Beech Lane, E.C.1.

Self-adhesive film has the advantage that it needs only to be pressed on the glass (again with the aid of a roller) and gives a better finished appearance than plain film applied with a separate adhesive. It is not absolutely necessary to cover the whole of the glass with this material, but naturally the closer the strips, the greater will be the protection (see 3 below).

When using this cellulose film it should be carried to the edge of the glass but not over the frames. The reason is that it tends to shrink slightly on exposure and if attached to the frames it will tend to lift at the edges of the glass.

N.B.—Since cellulose film, whether plain or self-adhesive, is affected by moisture, it is recommended that the treated panes should be given a water-proofing coat of a good pale varnish or lacquer.

B. (a) Cellulose Acetate Film.

The following materials have been approved :---

- (I) " Bexoid."
 - B.X. Plastics, Ltd., Hale End, E.4.
- (2) " Clarifoil."
- British Celanese, Ltd., Celanese House, Hanover Square, W.I. (3) "Dialux."
 - Dufay Chromex, Ltd., Elstree, Herts.
- (4) " Erinofort,"
 - Erinoid, Ltd., Stroud, Gloucester.
- (5) " Rhodophane."

Messrs. May & Baker, Ltd., 42-3, St. Paul's Churchyard, E.C.4.

(b) Cellulose Acetate Film reinforced with Textile Netting.

The materials supplied by the following firms have been approved :-

- (1) Cellofabrics, Ltd., 11, Gillingham Street, S.W.1.
- (2) Messrs, Dobsons & M. Browne & Co., Ltd., DelBeta House, Nottingham.
- (3) Dufay Chromex, Ltd., Elstree, Herts.

Cellulose acetate film cannot be stuck to glass satisfactorily with ordinary gum or paste, but most manufacturers can supply suitable adhesives for their own materials or suggest recipes for making them up.

(c) Self-adhesive Cellulose Acetate Film.—This type of film closely resembles in appearance the self-adhesive cellulose film mentioned above and is used in the same way. Varnishing is not quite so necessary in this case, as cellulose acetate film is less affected by moisture than cellulose film; nevertheless varnishing helps to preserve the film and adhesive and is therefore recommended.

The film marketed by the following firm has been approved :-

Durex Abrasives, Ltd., Arden Road, Adderley Park, Birmingham, S.

3.—STRIP TREATMENTS.

While treatments which are applied all over the glass, such as those described above, are to be preferred, strips of suitable strong materials spaced apart can often be used with good effect.

Obviously, the wider the strips themselves and the more closely they are spaced, the better. Provided the strips are at least $1\frac{1}{2}$ in. wide and are crossed one over another they may be placed up to 4 in. apart. If narrower strips are used or if the strips are not crossed, they must be placed closer together.

When using proprietary materials in strips, the manufacturers' recommendations should be followed.

Suitable materials for strip application include :---

- The transparent cellulose and cellulose acetate films mentioned in 2 above, particularly the self-adhesive varieties. After applying strips of these materials it is recommended to varnish over the whole area of the glass.
- (2) Self-adhesive cloth tapes—pressing these on the glass with a warm iron helps them to stick better.
- (3) Any strong textile material stuck on the glass.
- (4) Metallic strip applied with a suitable adhesive.

Thin brown paper is not very effective, but stout brown paper strips, closely spaced and well stuck to the glass, will provide some protection.

4.-LIQUID COATINGS.

A large number of liquid preparations based on rubber latex or synthetic resins have been placed on the market as "anti-shatter" coatings, but the general impression gained at the Station as to their value has not been very favourable since so many of those tested have been either ineffective in the first instance or have become so after a few weeks on the window.

The standard of durability which is at present adopted in tests on these liquids at the Building Research Station is that they should retain their efficacy for at least four months under normal conditions of exposure. In the case of rubber latex compositions, no accelerated ageing test is yet available which would serve to show whether a material submitted is likely to have the necessary durability; hence it is necessary to rely on natural exposure for four months before approval can be given.

In the case of synthetic lacquers, however, a heating test has been devised which serves to eliminate the more short-lived materials. If a material passes this test the Station is prepared to receive any authentic evidence which the manufacturers can furnish regarding its durability, for consideration with a view to granting provisional approval.

So far two materials, named below, have been found under actual test to remain effective for at least four months and there are some half-dozen others which have given promising results under the heat test; these are being further investigated.

The two approved materials are :---

(I) " Arpco."

The Calico Printers Association, Ltd., St. James Buildings, Oxford Street, Manchester, 1.

(2) " Slick."

Slick Brands, Ltd., Waddon, Croydon.

It cannot be too strongly emphasized, however, that to be effective and durable, these materials must be applied so as to give a fairly thick coating. A thickness of not less than 2/1000 m, should be aimed at and this means that at least two good coats, in addition to any priming treatment recommended, should be applied.

A lack of durability may not be so serious a matter if a fresh coat of the liquid is applied from time to time, say about every two months. The need for this, however, may not always be apparent, since treatments often become ineffective (by becoming brittle) without any change in their appearance.

For large panes of glass, liquid treatments alone are not recommended; in general, some other means of protection should be adopted, but a liquid treatment might be used in a supplementary capacity, *e.g.*, for treating areas of clear glass between strips of material such as those mentioned in 3 above. It is also possible to reinforce a liquid treatment by embedding a textile netting or transparent film in the coating.

APPENDIX.

TEXTILE NETTINGS.

The preparation of a standard specification for textile nettings for window protection is under consideration. This specification may have the result of bringing about an increase in the degree of protection provided by netting treatments.

In the meantime, the following nettings have been approved on the basis of present tests :--

Name and Address of Makers.	Number or Designation of Nettings Approved.
R. E. Ashworth & Co., Ltd., 37, Stoney Street, Nottingham.	(i) "Sunenta" large squares. (ii) ,, small ,, (iii) ,, atterned
Wallis Binch, New Basford, Nottingham.	(ii) No. 22. (ii) No. 7682.
Black Bros., Ltd., Stoney Street, Nottingham.	Anti-splinter net.
Carcy & Sons, Ltd., 45, Broad Street, Notting- ham.	Splinterproof Nets Nos. : 9643-027743-22810573 0210135
Edward Cope & Co., Ltd., High Church Street, New Basford, Nottingham.	No. 72 or No. 147.
Daybrook Fabrics, Ltd., Youngs Factory, Alfred Street South, Nottingham.	(i) Dessanita Quality No. 1. (ii) , No. 2.
John Dickinson & Co., Ltd., Home Park Mills, Kings Langley, Herts.	" Splinternet."
Dobsons & M. Browne & Co., Ltd., DelBeta House, Nottingham.	(i) No. GF3698. (ii) No. GF3958. (iii) No. 10480/GF31694.
Frymann & Fletcher, Ltd., Clyde Works, Denison Street, Nottingham.	Splinterproof Nets Nos. :
M. Jacoby & Co., Ltd., Nottingham,	No. 9387.
Alexr. Jamieson & Co., Ltd., Darvel, Ayrshire.	No. 7505.
Harry Johnson (Nottingham) Ltd., 38, St. Mary's Gate, Nottingham.	No. 4508.
Key A.R.P. Products, Keystone House, Adeline Place, W.C.1.	Splinterproof White netting.
W. J. & T. Lambert & Co., Ltd., Talbot Street, Nottingham.	 (i) Back glued net. (ii) Impregnated net. (iii) Mesquito net.
Levin Bros. & Co., Ltd., Middle Pavement, Nottingham.	(i) No. 9061. (ii) No. 9062.

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Name and Address of Makers.	Number or Designation of Nettings Approved.
Alex. Morton & Co., Ltd., Darvel, Ayrshire.	Anti-splinter Nets Nos. :
R. Newbold, Kayes Walk, Nottingham.	Anti-splinter, anti-dazzle.
A. & F. H. Parkes (Nottingham) Ltd., Anglo- Scotian Mills, Beeston, Notts.	" Nuart " Anti-splinter net.
C. & J. Robertson, Ltd., Ladeside Factories, Galton, Ayrshire.	(i) No. AS1. (ii) No. AS250.
Stirling Bros. & Co., Ltd., Darvel, Ayrshire. Frank Tatham, Ltd., 12, Plumtre Street, Nottingham.	(i) No. 14960. (ii) No. 34961/x. No. 252.
L. O. Trivett, Ltd., Trivett's Buildings, Short Hill, Nottingham,	(i) No. A4558. (ii) No. A4559.
Wallace & Co. (Netherplace), Ltd., Netherplace, Newton Mearns, Nr. Glasgow.	(i) No. A1. (ii) No. A2.
George Walton & Sons, High Pavement, Sutton- in-Ashfield.	Anti-splinter net.
J. & J. Wilson & Co., Ltd., Greenhead Mills, Newmilns, Ayrshire.	A.R.P. Nets Nos. : 8308368694A9051
A. Herbert Woolley & Co., Ltd., Nottingham.	(i) No. 0800/1. (ii) No. 0801/1. (iii) No. 0802/1.

All the above nettings were supplied ready-treated with adhesive. In addition, the following untreated netting has been tested in conjunction with

Further, the following nettings have been tested in conjunction with special varnishes or lacquers supplied with them for use both as the adhesive and as a subsequent coating, and have been found to be satisfactory :---

Beaver Anti-Splinter Varnish and Netting. Beaver Paint Co., Ltd., 20, Tithebarn Street, Liverpool, 2.

- (2) Cerrux Shatter Resisting Varnish S.3615 and Reinforcing Fabrics Nos. 1, 2 and 3. Cellon, Ltd., Kingston-on-Thames.

(3) Anti-Splinter Lacquer and Netting.

A. Holden & Sons, Ltd., Bordesley Green Road, Birmingham, 9. (4) Foochow Shatterproof Compound and Netting.

Donald Macpherson & Co., Ltd., 21, Albion Street, Manchester.



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